U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION, THOMAS F. HUNT, DIRECTOR; CHARLES F. SHAW, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF THE HEALDSBURG AREA, CALIFORNIA,

BY

E. B. WATSON, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN CHARGE, AND WALTER C. DEAN, C. J. ZINN, AND R. L. PENDLETON, OF THE UNIVERSITY OF CALIFORNIA.

MACY H. LAPHAM, INSPECTOR, WESTERN DIVISION.

[Advance Sheets Field Operations of the Bureau of Soils, 1915.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., January 16, 1917.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of the Healdsburg Area, Cal., and to request that they be published as advance sheets of the field operations of the Bureau of Soils, 1915, as authorized by law.

The selection of this area was made after conference with the State officials cooperating with the bureau in the work of surveying and classifying the soils of California.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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Soil map, Healdsburg sheet, California.

SOIL SURVEY OF THE HEALDSBURG AREA, CALIFORNIA.

By E. B. WATSON, of the U. S. Department of Agriculture, In Charge, and WALTER C. DEAN, C. J. ZINN, and R. L. PENDLETON, of the University of California.—Area Inspected by MACY H. LAPHAM.

DESCRIPTION OF THE AREA.

The Healdsburg area, California, lies in the central and north-central parts of Sonoma County. It extends southward and southeastward from the northern boundary of the county just north of Preston to a point about 7 miles southeast of Sebastopol. The area includes the agricultural lands of the Russian River Valley to the point where the river enters the gorge which it has cut through the Coast Range, and also the valley of Dry Creek, which lies west of the Russian River Valley and joins it at Healdsburg, near the center of the area. There is also included the larger part of the Santa Rosa Plain, which stretches south of the Russian River Valley, and the low, rolling hills of the Sebastopol district lying west of this plain.

FIG. 1.—Sketch map showing location of the Healdsburg area, California.

The area surveyed is about 40 miles long and 6 to 12 miles wide, and is quite irregular in outline. It is bounded by prevailingly nonagricultural land on all sides except along the southern part of the eastern boundary, where it adjoins the area covered by the soil survey of the San Francisco Bay region.[1] The Healdsburg area covers approximately 348 square miles, or 222,720 acres, and includes practically all the agricultural land in Sonoma County except that included in the map of the San Francisco Bay region.

The base map used in the survey was made by the field party by plane-table traverse, as no map suitable for the purpose of plotting the soils was available.

The Russian River enters Sonoma County at the northern boundary through a narrow gorge flanked on each side by rough and mountainous land. About 1 mile south of the boundary the gorge abruptly widens into a fertile valley which, including bottom and terrace land, ranges from 1 mile to 1½ miles in width. This extends in a south-

[1] Reconnoissance Soil Survey of the San Francisco Bay region, Field Operations of the Bureau of Soils, 1914.

easterly direction for about 13 miles and then expands into Alexander Valley, which seems to be a recently filled basin. This valley is 7 miles long and has a maximum width, at Lytton, of 3½ miles. Upon issuing from Alexander Valley the river turns west and enters the inclosing highlands near Fitch Mountain. It follows a meandering course through a narrow gorgelike valley, from which it emerges at Healdsburg, where it is joined from the northwest by Dry Creek. This stream flows through a fertile valley about 12 miles long and 2 miles across in its widest part. The agricultural land within the area north of Healdsburg thus consists of the Russian River Valley, long and narrow, which terminates in Alexander Valley, and Dry Creek Valley, lying parallel to it. These two valleys are separated by a ridge which, in the southern half, has a low agricultural value.

South of Healdsburg the character of the country changes. It can best be described as a broad plain stretching away southward and southeastward to Santa Rosa and beyond, until it reaches sea level at Petaluma. The Russian River skirts this plain on the west before it cuts through the Coast Range. The earlier soil survey of the San Francisco Bay region covered the southeastern part of this plain. West of the southern part of this plain is the Sebastopol district. This consists of a series of low, rounded hills, cultivated and well improved, which gradually give way on the west and south to hills which are higher and more rugged. Bordering the several valleys, the low hills, and the plain described above is rolling to steep hilly country, mainly nonagricultural. These hills rise from 500 to about 2,000 feet above the valley floor, the elevation becoming greater with distance from the valleys. The hills in the main are smooth rather than rugged, but rocky ravines and occasional outcropping ledges occur. These hills, which represent the Coast Range, lie in more or less discontinuous ridges parallel to the Russian River and Dry Creek Valleys. Mount St. Helena, much the highest peak in this locality, attaining an elevation of 4,343 feet above sea level, lies outside the area, about 10 miles east of Healdsburg. Sulphur Peak or Geyser Peak, about 5 miles northeast of Geyserville, is 3,471 feet high.

Practically all the drainage of the Healdsburg area is into the Russian River. In the northern part small streams from both the east and the west are tributary to the Russian River and to Dry Creek. They have high gradients and flow in V-shaped valleys in the hills, but their gradient is very much less after they reach the floors of the valleys.

Two fair-sized streams, Mark West Creek and Santa Rosa Creek, drain the hills to the east of the southern part of the area. These streams flow west across the Santa Rosa Plain in channels only a few feet deep. They empty into the Laguna de Santa Rosa, a very sluggish stream which enters the area from the south between the Santa

Rosa Plain and the hills of the Sebastopol region and receives the drainage from the plain to the east. The Laguna de Santa Rosa empties into the Russian River. Near Sebastopol it flows through a series of ponds and wide marshes. The periodical alluvial deposits along Santa Rosa and Mark West Creeks in their lower courses are quite noticeable and in favored localities may average a depth of 3 inches a year.

The drainage of the hills of the Sebastopol district goes mostly into Green Valley Creek, which flows north into the Russian River. The only part of the Healdsburg area not tributary to the Russian River is a few square miles near Freestone, in the southwestern part. The drainage here is carried by a small stream to the south.

The Russian River pursues a very peculiar course through this area. In the northern part it follows a relatively straight course from Cloverdale through Alexander Valley over a broad flood plain, swinging from side to side and constantly moving its channel as it builds up its flood plain. It has here the course and characteristics of a middle-aged river actively at work. Where it enters the highlands between Alexander Valley and Healdsburg it follows a narrow gorge and pursues a course 15 miles long in gaining a distance of 4 miles. The stream follows meanders such as are ordinarily made by a river in extreme old age, when it has reached base level and trifling obstructions serve to swing it in wide loops over its flood plain. On leaving these highlands the river, instead of following the direct and relatively easy course southeast across the Santa Rosa Plain, which lies 100 to 150 feet above sea level, skirts this plain on the west, where it has cut a channel in the western slope, and finally cuts across the highlands to the ocean through hills that are from 800 to 1,200 feet high.[1]

A few settlers had established themselves in this area prior to 1850. In 1835 three men sent out by Gen. Vallejo settled near Freestone, making probably the first white settlement within the area. In 1845 one or two settlers came into Alexander Valley. In 1846 a store was established at Healdsburg. Santa Rosa was first settled in 1852 and in 1855 was made the county seat of Sonoma County. Green Valley was settled before 1850, and by 1853 was a place of considerable importance. From 1850 to 1855 the increase in population in the area was comparatively large, and settlement became well distributed over the better lands. Green Valley apparently was the first part of the area to show marked development, but it

[1] See "The Russian River," by R. S. Holway, Univ. of Cal. Publications in Geog., vol. 1, No. 1. Holway is of the opinion that the present course of the river was determined when it was flowing over a nearly level plain practically at sea level, and that the Coast Range mountains were subsequently so slowly elevated that the river succeeded in cutting through them and in maintaining substantially its original position. The terraces occurring in many places in this area mark the extent of the successive uplifts of land rather than of the lowering of the river.

was closely followed by Dry Creek and Alexander Valleys. The early settlers came from all parts of the United States, but Missouri, Kentucky, Tennessee, and Pennsylvania furnished the largest numbers. Probably 25 per cent of the homeseekers were foreigners.[1]

The predominating population to-day is of Anglo Saxon extraction, but there are a large number of persons of other races. Many Italians and Swiss have settled in the area within the last 30 years. These are mostly engaged in industries connected with grape growing and wine making. Next in importance are Japanese, who are engaged largely in the fruit and truck industries. There are also an appreciable number of Indians, remnants of the important tribes that originally had their homes in the various valleys.

The Goldridge district, including Green Valley and Sebastopol, has a dense rural population, as the separate land holdings are small. The population is only slightly less dense along the alluvial lands of the Russian River and Dry Creek and on the alluvial fan east and north of Fulton. The population of the Santa Rosa Plain is much less dense, as this is given over mostly to large dairy farms. The settlement in the hills is very sparse.

Healdsburg, situated near the center of the area, is the principal town. It has a population of a little more than 2,000. Cloverdale, with a population of nearly 1,000, is situated near the northern part of the area. Geyserville, with 550 inhabitants, is 10 miles south of Cloverdale. Asti, Lytton, Mark West, Windsor, and Fulton are small villages on the main line of the Northwestern Pacific Railroad. This line traverses the area north and south, following along the Russian River from Cloverdale on the north to Healdsburg and then crossing the level plains to Santa Rosa. This railroad provides an outlet to the cities on San Francisco Bay and through them to the markets of the world. On the north it connects this area with Mendocino and Humboldt Counties.

Sebastopol is the principal town of the Goldridge district. It has a population of about 1,500. This town is connected by a branch line of the Northwestern Pacific Railroad with Santa Rosa, 7 miles to the east, and by electric lines with both Santa Rosa and Petaluma. Forestville and Graton are small towns in this neighborhood, connected by electric railway with Sebastopol. Freestone, Occidental, and Camp Meeker are on the western limits of the area, on a branch of the Northwestern Pacific Railroad which connects them with Sausalito. Another branch of this railroad extends west from Fulton to the lower Russian River and coast districts.

[1] Much of the information concerning early settlement and agriculture in the area has been obtained from the "Sketch Book," by Manefee, published in 1873, and a history of Sonoma County, published in 1877. Some information was also obtained from the census reports and from interviews with old settlers.

Santa Rosa, a city of about 8,000 inhabitants, is the county seat of Sonoma County. It lies just outside the area, east of the southern part, and is the market for a large part of the agricultural products.

There are ample public roads in the more level parts of the area, and they are kept in fair condition. In the uncultivated, hilly region there are very few roads and some of them are quite poor. One branch of a State highway extends from Santa Rosa north through Healdsburg, Geyserville, Cloverdale, and beyond the northern limits of the county. That part from Santa Rosa to Healdsburg is surfaced and the section north of Cloverdale is under construction. The remainder of this highway is not yet surfaced, but is kept in excellent condition.

CLIMATE.

The climate of the Healdsburg area is characterized by a rainy season, which is coincident with the winter months, and a dry season which occurs during the summer. The annual rainfall averages between 32 and 40 inches. The precipitation usually occurs in the form of quiet rains which may be of several days' duration. The first usually occur in October and the last in April or May. The rainfall varies considerably from year to year, ranging from 15.71 inches at Santa Rosa in 1898 to 65.52 inches at Healdsburg in 1909. Healdsburg, in the central part of the area, has a greater rainfall than Santa Rosa. In the southern part, however, there is considerable fog during the early summer months, and this is of some benefit to vegetation.

The temperature in the winter rarely goes much below freezing, but frosts are likely to occur from October to April. Snow occasionally falls, especially on the hills, but snowfalls do not last long. The summers are warm, but are tempered more or less by fogs and sea breezes, especially in the southern part of the area.

In the Russian River and Dry Creek Valleys north of Healdsburg, which are more inclosed, the climate is apparently warmer and drier in the summer than elsewhere, although there are no weather records on which to base a definite statement.

During the summer months, when the trade winds are blowing, the prevailing wind is from the west or northwest, but its direction varies in different parts of the area with differences in the height and position of the surrounding hills. Wind action is strong enough in the southwestern part of the area to affect materially the growth of trees.

The climate over the area as a whole seems especially suited to most of the deciduous fruits. It is favorable for early apples but less favorable for late apples. The local climatic conditions are well suited to prunes in the vicinity of Healdsburg and especially well

suited to wine grapes. It seems to be too dry for the best development of corn, but conditions are quite well suited to the more drought-resistant sorghums and Kafirs. Navy beans give low yields, owing to killing of the blooms by hot spells. The native grasses make a luxuriant growth during the rainy season, but dry up in the summer.

In the following table are given climatic data from records of the Weather Bureau station at Healdsburg, which is near the center of the area, and at Santa Rosa, which is just east of the southern part of the area.

Normal monthly, seasonal, and annual temperature and precipitation at Healdsburg and Santa Rosa.

Month.	Healdsburg.				Santa Rosa.			
	Temperature.	Precipitation.			Temperature.	Precipitation.		
	Mean.	Mean.	Total amount for the driest year (1898).	Total amount for the wettest year (1909).	Mean.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	*Inches.*	*Inches.*	*Inches.*	°F.	*Inches.*	*Inches.*	*Inches.*
December	46.0	7.03	1.14	7.51	48.9	5.61	1.20	4.50
January	44.6	10.05	1.61	33.68	48.0	6.85	1.81	1.77
February	48.1	7.34	8.71	13.17	50.5	5.22	5.32	12.23
Winter	46.2	24.42	11.46	54.36	49.1	17.68	8.33	18.50
March	50.3	6.87	.43	4.52	52.6	5.11	.60	12.93
April	54.9	2.74	.33	.00	56.4	1.64	.38	2.99
May	58.7	1.73	4.07	.00	62.0	1.52	3.38	.24
Spring	54.6	11.39	4.83	4.52	57.0	8.27	4.36	16.16
June	63.9	.35	.41	.13	66.8	.25	.17	.07
July	66.8	.03	.00	.00	67.2	.05	.00	T.
August	64.8	.01	.00	.00	65.0	.01	.00	T.
Summer	65.2	.39	.41	.13	66.6	.31	.17	.07
September	62.8	.58	.76	1.34	64.2	.53	.62	4.39
October	59.4	2.27	.78	3.31	59.6	2.02	1.07	4.00
November	54.0	4.49	1.06	2.84	53.9	3.20	1.16	2.74
Fall	58.7	7.34	2.60	6.51	59.2	5.81	2.85	11.73
Year	56.2	43.54	19.30	65.52	58.0	32.07	15.71	46.46

The average monthly rainfall at Cloverdale for the years 1909 to 1913, inclusive, as given in the report of the California Development Board, is as follows: January, 14.74 inches; February, 5.52; March, 5.77; April, 1.85; May, 0.93; June, 0.11; July, 0.08; August, 0.00; September, 0.97; October, 1.01; November, 4.57; and December, 5.90. The mean annual precipitation is 41.45 inches.

The average date of the last killing frost in the spring as recorded at the Weather Bureau station at Healdsburg is April 8, and that of the first in the fall, November 16. Killing frost has been recorded here as late in the spring as April 17 and as early in the fall as October 13. The period free from killing frosts is somewhat longer at Santa Rosa, where the average date of the last killing frost in the spring is April 24 and that of the first in the fall, December 10. The latest killing spring frost on record at the Santa Rosa station occurred May 10 and the earliest in the fall on October 29.

AGRICULTURE.

Cultivation of the soil in this area began about 1850. The first agriculture consisted mainly of stock raising, but the growing of grain, fruit, and potatoes was begun at about the same time. Potatoes have been grown on a commercial scale in the extreme southern and southwestern parts of the area since the first settlement. In 1850 one settler near Freestone produced a big crop of potatoes, and the good price obtained for these stimulated potato growing. The next year one farmer planted a ton of seed potatoes in Green Valley. In 1854 there were 2,600 acres devoted to the crop in Sonoma County. Potato growing has in some years been unprofitable, but the industry is still carried on.

Fruit growing is reported to have been begun in Green Valley in 1850, and by 1855, there were 6,730 fruit trees in this district, about one-third of which were bearing. The fruits included apples, peaches, pears, apricots, quinces, figs, and plums. Prunes apparently were not produced at this time. The first vineyards were planted during the same period, not only in Green Valley but in Dry Creek Valley and at various places along the Russian River. One old vineyard of Mission grapes on the Pleasanton gravelly sandy loam soil in Dry Creek Valley, which is said to have been planted in 1850, is still bearing, although the yields are decreasing on account of phylloxera.

Hop culture began about 1872, in which year 26 acres are reported in this crop. The increase in hop culture was apparently rapid, for in 1876 the shipping point of Cloverdale reported 327,000 pounds of hops shipped. Hop growing has continued to flourish to the present time.

In 1870 the Northwestern Pacific Railroad was constructed to Santa Rosa, and by 1872 it reached Cloverdale. The building of this railroad aided greatly in developing the more intensive forms of agriculture.

The general tendency of the agriculture of the area has been a development of fruit growing and intensive forms of agriculture on all the soils suited to them, at the expense of grain and stock farming. This change is still going on, although in general nearly all the soils

best suited to intensive agriculture have been occupied. Most of the soils now being developed are not so well suited to intensive agriculture, on account of poor drainage, heavy texture or shallowness. Some of these soils on which attempts at fruit growing are being made will probably revert eventually to pasture lands.

Agriculture at the present time is, on the whole, in a very flourishing condition. In the well-developed sections the appearance of the houses, ranches, and equipment indicates that farming has been very profitable. The agriculture can best be studied in detail through a discussion of the individual crops and types of farming.[1]

Apples.—The Goldridge district, with Sebastopol as the main shipping point, is one of the noted apple regions of California. This district extends from Freestone on the south to Forestville on the north. The success in apple growing here is evidently due to favorable conditions in both soil and climate. The soil is, in the main, the Goldridge fine sandy loam, but there are small inclusions of Altamont gravelly fine sandy loam. (See Pl. I.) The factors in these soil types which make them especially suited to the apple seem to be the friable nature of the surface soil, which absorbs the winter rains and in the summer readily forms a mulch that conserves moisture, and the clay loam subsoil, which makes a good storage reservoir for moisture. The subsoil here is not a clay, as it is often considered by observers, but a friable clay loam. It is readily penetrated by roots, and even the underlying rock is so friable that roots enter it easily. The factors in the weather that seem to favor the apple are the moisture-laden winds from the ocean, which modify the summer heat. Even with this help only the early apples, such as the Gravenstein, reach perfection. Late apples all mature in the fall and are not good keepers. Nearer the southern end of this region apples are a failure. The soils are the same as those farther north, but the winds from the ocean, which here is only 6 to 10 miles away, blow in every day and are apparently detrimental to the trees.

The Gravenstein apple ripens early and usually finds a good market. Most of the apples are shipped through packing associations as fresh fruit. The culls are either dried or sold to the vinegar factory. Other varieties of apples grown are the Bellflower, Spitzenberg, Yellow Newtown, Wagener, Rome Beauty, and Baldwin. It is said that two-fifths of the apple output is of the Gravenstein variety, and the reputation of this region as an apple-producing center rests on this variety.

Apples are also grown in Dry Creek Valley, around Healdsburg, and in small scattered orchards in all parts of the area, but outside the main apple-growing district they are not considered as profitable

[1] Many of the statements in this detailed discussion have been taken from an unpublished report on Sonoma County, made by A. J. Sturtevant, jr., for the California Development Board, in 1914.

as other fruits. It is essential that the apple orchards be sprayed regularly and also pruned. Summer thinning of fruit is not usually practiced.

Berries.—The Goldridge district, besides being noted for its apples, has become a section of extensive berry production. The growing of berries has gone hand in hand with apple orcharding and has been of almost equal importance economically, since by growing berries between the rows of trees the land has produced a profit beginning with the second year instead of remaining unremunerative while the trees were coming into bearing. Berries are grown to a smaller extent around Healdsburg and in the Dry Creek Valley, and in a small way in all parts of the area where other fruits are grown. There are in the aggregate about 1,200 acres of berries in the area. The varieties grown are the Lawton blackberry (Pl. I), the loganberry, the Mammoth blackberry, and some strawberries. Berries give an average yield of about 2 tons per acre. The Lawton blackberry constitutes about one-half the berry crop. A berry growers' association in Sebastopol, with a membership of 400, markets 95 per cent of the production of that neighborhood.

Cherries.—Cherry production is one of the increasingly important industries of the area. There is a large acreage in cherries at present and it is steadily expanding. The principal cherry-growing section is around Sebastopol, but a large quantity of this fruit is produced near Healdsburg and in the Dry Creek Valley. Any good fruit soil of friable, deep character seems to be suited to the cherry and in this area a suitable location for cherry orcharding apparently depends more on the climatic conditions than on the nature of the soil. Local conditions of air drainage, frosts, and protection from winds have much influence. Favorable localities can be proved only by experience. At best, the cherry is an irregular crop, but the returns in good years make up for several years of light yield. The Royal Ann (Napoleon Bigarreau) is the favorite variety grown, and the Black Tartarian is second. Varieties grown to a small extent are the Centennial, Rockport, and Bing.

Citrus fruits.—Throughout the area are scattered citrus trees. In the vicinity of Cloverdale there are several small plantings of oranges, lemons, and grapefruit, but the production of citrus fruits has not been developed.

Grapes and wine making.—The production of wine grapes is probably the leading farm industry in amount of capital invested. No raisin grapes are grown, and they could not be successfully dried in the open in this area. Practically no table grapes are grown, except a small quantity for local markets. Grapes are the predominating crop in the northern part of the area from Oat Valley, above Cloverdale, to Geyserville. (See Pl. II.) From here southward they are

grown in abundance, but in association with other crops. (See Pl. III.) Grapes are grown on practically all the soils in the area, with different degrees of success. On the rich alluvial lands large yields are obtained, but the grapes are lower in sugar and make a poorer grade of wine. On the bench lands, of old valley-filling soils, the yields are satisfactory and the quality excellent. Grapes are also grown on the steep hillsides in the eroded parts of the older valley-filling soils and of the residual soils, where cultivation is difficult and yields are light and it is a question whether their production is profitable. The total acreage in grapes at present is not as large as it was some time ago, on account of the ravages of phylloxera, which has killed the vines over thousands of acres. Many of the vineyards so destroyed were reset to vines on resistant stock, and in all the new vineyards the same precaution against phylloxera is taken. In Dry Creek Valley the grape-growing industry is decidedly on the wane. The rich soils in this valley are found to be more profitably planted to other fruits, notably the prune. Very few new plantings are being made in the area and many of the well-established vineyards are being interplanted with prunes, not so much because of dissatisfaction with the returns from grapes as from fear of adverse legislation which would make the vineyards valueless.

Yields of grapes are said to average about 3 tons per acre for the whole area. They range from less than 1 ton in some of the hill vineyards to as much as 15 tons in rare cases on the rich bottom soils. The varieties chiefly grown are the Zinfandel, Reisling, Petite Sirah, Alicante Bouschet, and Carignan. There are about 150 wineries in Sonoma County, and these place on the market about 10,000,000 gallons of dry wine each year. Probably three-fourths of this is produced in the Healdsburg area.

Olives.—Olives are grown mostly as border trees or as isolated specimens here and there over the area, but occasionally they are produced in small orchards. Those grown are of all varieties and receive little care. There is no well-established local market for the fruit.

Peaches.—The production of peaches in this area was formerly much greater than it is at the present time. When the trees have begun to decline they are taken out and replaced by more profitable fruits, notably the apple and the prune. Peaches of good quality are grown, but it has been difficult to market them profitably. The varieties grown are the Crawford, Muir, McClish Cling, and Phillips Cling. Peaches are grown chiefly in the Sebastopol section and in Dry Creek Valley.

Pears.—The Bartlett pear is one of the most extensively grown fruits in the area. The acreage is not as large as that of prunes or apples, but pears rank next in number of trees and are growing in

popularity. The climate and soil seem especially well suited to this crop, and as the localities where the pear succeeds are quite limited the markets are not likely to be flooded. The Bartlett is the only variety grown for market. Small pear orchards are scattered over the area, but the principal plantings have been made near Healdsburg and in Dry Creek Valley. The pear does well on all the recent-alluvial soils. It is a common practice to grow pears in the more poorly drained situations, as they seem to stand poor drainage better than the other fruits. There are some scattered trees that have grown well and yielded satisfactorily on well-drained Pleasanton gravelly sandy loam and Corning gravelly loam, and it seems probable that commercial orcharding would be profitable on these types. The crop is usually sold to canneries, of which there are several in the area.

Plums.—From 50 to 75 carload lots of fresh green plums are shipped from the Healdsburg section each year, in addition to which a large quantity is canned. The Tragedy, Wickson, and Burbank varieties are the favorite shipping plums. The Yellow Egg, Jefferson, and Golden Drop are grown mainly for canning.

Prunes.—Prunes constitute one of the most extensively grown crops of the area. Prunes are produced in all parts of the area, but mainly in the Healdsburg section, which includes Dry Creek Valley and Alexander Valley. It is reported that the favorable soil and climate here produce a prune which, for combination of color, size, thinness of skin, and sugar content is not excelled anywhere.

The soils on which most of the prunes are produced are the stream-bottom phases of the Yolo silt loam and the Yolo fine sandy loam. (See Pls. IV and V.) On these types the French prune reaches its highest perfection and is most profitable. Practically every soil type in the area, however, is devoted to prunes to some extent. The French prune, which is the main commercial sort, does not attain satisfactory size on any except the rich, well-drained alluvial soils. On the older, drier soils the prunes run so small in size that the crop is not profitable. The Imperial or Clairac Mammoth is a larger prune than the French, but on the rich alluvial soils the fruit is very soft and does not dry satisfactorily. On the gravelly alluvial soils, such as the Yolo gravelly loam, and on the older valley-filling soils, such as the Pleasanton gravelly sandy loam and the Corning gravelly loam, the Imperial reaches perfection and is very profitable. It yields well, attains a moderate size, has a good sugar content, and dries readily. The adaptation of these soils to the production of the Imperial prune has been recognized but recently, and extensive plantings are now being made on them. The Robe de Sergeant and Sugar prunes are grown to a small extent.

One of the main factors in successful prune growing is the climate. Prunes do not stand continuous hot weather or sudden changes. Prolonged hot periods cause a red color and thick skin, and sudden changes in the weather may cause the fruit to drop or may injure the tree. The mild climate around Healdsburg seems to be particularly favorable to the prune. The fruit grown here is black, with a smooth, tough skin, and has a good sugar content and texture. Prunes grown around Cloverdale, where the temperature is higher, have a red tinge. In any moister climate the drying conditions would be less favorable.

In a normal year about 7,500 tons of prunes are produced in the Healdsburg section, that is, within 8 miles of Healdsburg, and about 2,000 tons in other parts of the area. The market for prunes fluctuates somewhat, but in late years the price has never been below the cost of production. The prune growers are organized and do part of their marketing through cooperative packing houses.

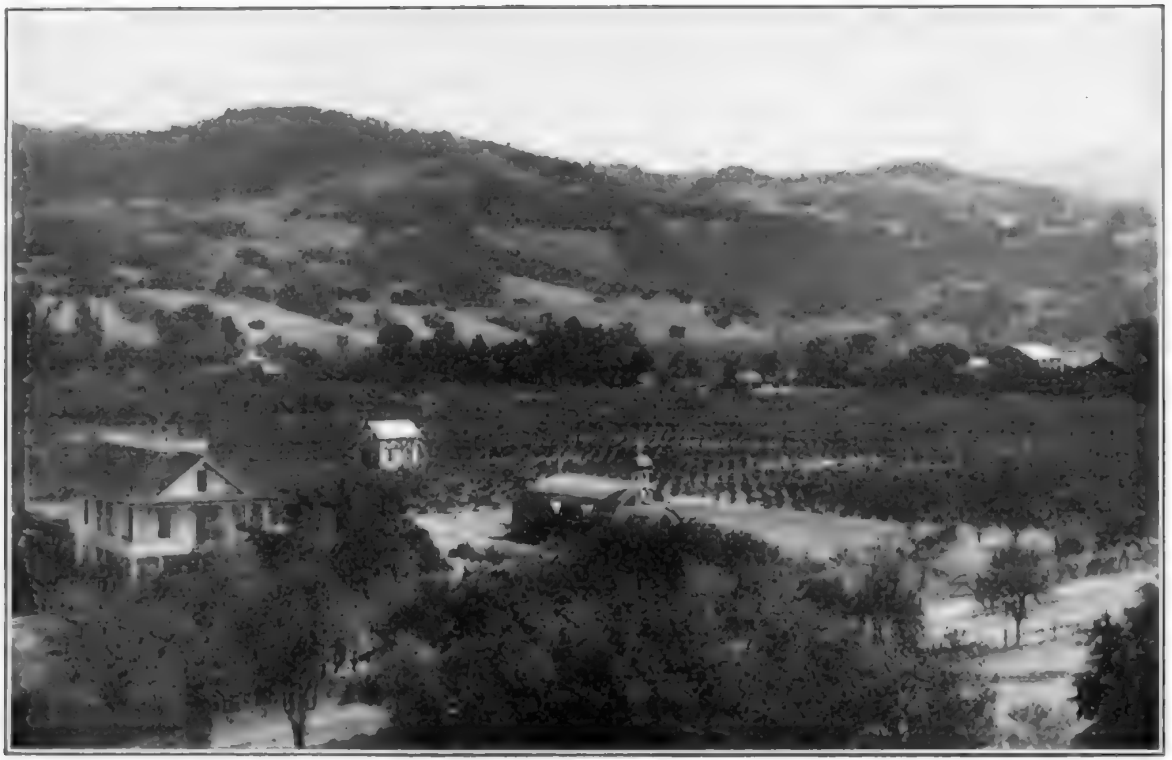
Walnuts.—There are no large orchards of English walnuts in the area, but they are grown as border trees or isolated trees in all parts of the area and there are a few small orchards. The rich, deep, alluvial soils seem best suited to the walnut. The climate of the area appears to be favorable, and the greatest drawback to walnut growing at present is the blight, which in a number of cases noted had entirely destroyed the crop on small plantings.

Tomatoes.—Tomatoes are grown both as an auxiliary crop in nonbearing orchards and to some extent as a primary crop. Their commercial production is centered mainly around Healdsburg. Smaller acreages are planted near Sebastopol and Santa Rosa. Tomatoes do best on the Yolo silt loam and fine sandy loam. Yields are reported as ranging from 8 to 20 tons per acre, with an average yield of about 12 tons. The crop is usually sold to canneries. The variety grown is known as the Kennedy tomato. This has large, handsome fruit, but it contains more water than some other varieties. Tomato growing has been a very important industry, and the profits have in the main been very satisfactory.

Hops.—There were 4,280 acres devoted to hops in Sonoma County in 1914, and practically all of this acreage was in the Healdsburg area. Hops are grown on the alluvial lands bordering the Russian River and on the low alluvial fans bordering Mark West Creek and Santa Rosa Creek. The crop requires a very rich, deep, and friable soil. Practically all the hops produced in the area are grown on the Yolo fine sandy loam and the Yolo silt loam. (See Pl. IV.) The best yields are obtained on the silt loam. Hop growing is a very important industry, but the acreage devoted to this crop has not increased during the last few years. The climate of the area seems

ORCHARD ON THE GOLDRIDGE FINE SANDY LOAM, NEAR SEBASTOPOL.

Young Gravenstein apple trees with interplanted Lawton Blackberries.



VIEW AT ASTI, SHOWING SOME OF THE DRY-WINE VINEYARDS IN THE NORTHERN PART OF THE AREA.

Soils in the foreground mainly those of the Yolo series. The hill lands in the distance are Rough mountainous land and the various types of the Altamont series.

well suited to hops. The yield averages about 1,400 pounds per acre. The quality of the crop is the very best.

Alfalfa.—This area is not an extensive alfalfa-producing section, but alfalfa is grown in many small fields, usually in connection with dairying. It is almost invariably grown on the alluvial soils, the Yolo fine sandy loam and silt loam being preferred. Very little of the crop is irrigated, although experience has shown that irrigation is profitable. Three cuttings a season are usually made, and the total yield per acre averages 3 to 4 tons of cured hay.

Grain and grain hay.—A considerable acreage is devoted to wheat and oats. These crops are grown to some extent for the grain, but mainly for hay. The production of hay exceeds the local requirements, a surplus being shipped to outside markets. These grains are grown mainly on the heavy soils, especially the Dublin clay loam and clay adobe. These types are not the best for grains, but the lighter textured soils are much more profitably used for fruit, hops or alfalfa, while grain does as well on these heavy soils as any other crop, if not better. Grain is also grown extensively on the Altamont silty clay loam and the Aiken loam, which occur in rolling situations adjoining the more level parts of the area. In the better parts of these soils grain does very well. It is possible that as the country becomes more thickly settled the soils now used for grain will be found suited to more intensive types of farming. The large combined harvesters used on the large grain fields in the interior valleys of the State are not used in this area, owing probably to the small size of the fields. Thrashing is done by stationary machines. Wheat, on the average, yields about 10 sacks per acre, and oats about 15 sacks.

Subsistence crops, such as garden truck and fruit for home use, are grown throughout the area. Practically no agricultural products are shipped in for consumption on the farms, except those which can not be produced in the area.

Dairying.—Dairying is an important industry in the Healdsburg area. It is most extensively developed on the Santa Rosa Plain, since the soils here, mainly the Fresno and Madera loams, are not well suited to fruit. Dairying is also engaged in to a greater or less extent on the shallow, residual soils. The cows are allowed to graze on the native grasses during the winter and spring and in the summer and fall are turned into the stubble fields and fed more or less grain and hay. Some of the milk produced is sold fresh in the adjoining towns, but most of it is separated on the farm and the cream sold to creameries.

Stock raising.—Beef cattle, sheep, and hogs are raised on all the rougher and less desirable lands in the area, but stock raising has

gradually been abandoned on the better soils, owing to the greater profits in fruit production.

Poultry.—Much poultry is raised in this area, though poultry production is not nearly so well developed as in the vicinity of Petaluma, immediately to the south. There are many small ranches given over entirely to poultry raising and many more on which poultry constitutes only one of the products of the farm. White leghorns are the favorite breed of chicken. Only white eggs bring the top price. Brown eggs are classed with the smaller white eggs as seconds. The lighter textured soils with a sloping surface are considered much the best for poultry farming. Kale is grown for green feed.

Irrigation.—Only a small acreage of land is irrigated in the Healdsburg area. The farmers have adapted their crops and cultural methods to the available supply of moisture in the soils, but it seems probable that yields could be materially increased in many instances with irrigation. Some alfalfa fields and a few orchards on the Russian River flood plain are irrigated with water pumped from the river, with gasoline or electric power. The land is rarely checked for irrigation, as is done in the large interior districts of the State, the water being run over the surface by means of pipe, hose or ditches.

Output of canneries.—There are two canneries at Healdsburg, one at Sebastopol, one at Graton, and one at Santa Rosa, just outside the area. The following table, taken from the report by A. J. Sturtevant, jr., to which reference has already been made, shows the average tonnage of canned fruit produced in Sonoma County, the average price paid the farmer, and the season of canning. The average annual output is 300,000 cases of fruit and vegetables. Approximately 75 per cent of this is produced in the area covered by this survey.

Average output of canned goods in Sonoma County.

Fruit.	Production.	Price per ton.	Canning season.
	Tons.	*Dollars.*	
Apples	500	[1] 12	Sept. 5 to Nov. 1.
Apricots	Small.	25	July 10 to Aug. 1.
Blackberries	3,500	50	July 10 to Sept. 15.
Loganberries		55	June 1 to July 10.
Raspberries		120	June 10 to July 20.
Cherries	1,200	100	May 25 to July 20.
Peaches	2,000	20	July 25 to Sept. 20.
Plums	800	18	July 20 to Aug. 25.
Pears	2,500	25	Aug. 5 to Sept. 10.
Tomatoes	5,000	7	Sept. 20 to Nov. 10.

[1] Only the poorer grades are used for canning.

The farms devoted to fruit and hops are mainly well equipped with the most improved machinery, and the land is farmed in many

respects according to modern methods. Practically no commercial fertilizers are used, however, and cover crops have not been largely grown. The farmers are gradually realizing the need of keeping up the productiveness of the soil and are beginning to use cover crops. There is very little definite information in regard to the best cover crops to use on the different soil types and for the different crops. On the grain farms the equipment is often inadequate, and the same farming methods are in use as those prevailing when agriculture was first begun.

The labor supply is in general adequate, but the quality is not always the best. Most of the work on the fruit and hop farms is done by transient labor and much of it is piecework. Hops and cherries are picked by the pound, while the harvesting of prunes is paid for by the 50-pound lug box. As the prunes are picked from the ground, children do a large part of the work. Two dollars a day is about the average wage paid to transient farm laborers. Most of the laborers are of European descent. There are quite a number of Japanese in the area, who contract to care for hop yards and to prune orchards or pick fruit. There are also a few Indians, who work in the hop fields in the growing season and cut wood during the winter.

The 1910 census reports 79 per cent of the farms as operated by owners. This proportion has remained nearly constant for the last 30 years.

The price of farm land in the Healdsburg area varies greatly from place to place, owing not only to differences in productiveness and development of the soil, but to social conditions and speculative value. From $200 to $400 an acre is asked for the best undeveloped alluvial land of the Yolo, Honcut, and Tehama series, while from $600 to $1,000 an acre is asked for bearing orchards on these soils. Prices nearly as high are commanded by land of the Goldridge fine sandy loam type. The lighter soils of the Dublin series are held at nearly as high prices as the adjoining Yolo soils, but the heavier members have a much lower value. The old valley-filling soils, those of the Pleasanton, Corning, and Pinole series, are held at $100 to $200 an acre undeveloped and at as much as $500 or $600 an acre where in bearing fruit trees. Some land of the Fresno and Madera soils has been subdivided into small holdings and sold at $125 to $250 an acre. These soils are less productive than those mentioned above, and the rental value of the large ranches on these soils used as dairy farms and for grain growing is only $3 to $4 an acre per year. The residual hill soils, those of the Altamont, Aiken, Olympic, Butte, and Sites series, sell at $5 to $50 an acre, the price varying with the native covering, the topography, and the depth of soil. Parklike land well covered with grass brings a good price. The Sites gravelly loam where level enough to be used for fruit culture brings as much as $100 an acre.

SOILS.

RESIDUAL SOILS.

The rocks making up the hills forming the more elevated parts of the Healdsburg area are much intermixed. They consist of sandstones, shales, and conglomerates that have suffered varying degrees of metamorphism. Some of these rocks have been changed but little; others have been highly altered. Some are very soft, and weather and erode rapidly, while others are harder, weather much more slowly, and give a more rugged outline to the hills formed by them. Among the harder rocks are the radiolarian cherts. Included among these sedimentary rocks are numerous intrusives, some of which also have suffered great metamorphism. The igneous rocks [1] consist of basalt, diabase, and others, some of which have become thoroughly serpentinized. The beds and strata of these various rocks have been very much tilted, broken, and warped. Practically none of the sedimentary rocks are horizontal, as they undoubtedly were when laid down, but lie at all angles and usually more nearly vertical than horizontal in position. They show very little continuity, as much fracturing and tilting have taken place.

As a result of this, the residual soils, derived by the weathering in place of these various rocks in the more elevated parts of the area, occur in very small bodies and are extremely difficult to map. Some of these formations are classified by the United States Geological Survey as the Franciscan series of rocks, but some of them are probably much younger. The soils derived from them are, for the most part, very shallow, and owing to this as well as to their steep topography are in general nonarable. Such areas are mapped mainly as Rough mountainous land. Over a small proportion of these higher hills the soils are arable and have been classified and mapped as individual types. They are classed in four series: The Aiken series, consisting of red soils derived from basic or quartz-free, igneous rocks; the Olympic series, of brown soils derived from basic igneous rocks; the Altamont series, of brown soils from sedimentary rocks; and the Sites series, of red soils from sedimentary rocks.

Associated with these hills, but usually having a lower elevation, are hills occupied by rocks of much younger formations, which have been less broken and disturbed, lie nearly horizontal, and are more continuous. Notable in this kind of formations are the soft sandstones that have produced the extensive and uniform Goldridge soil. There are also the associated soft sandstones and conglomerates that have produced two members of the Altamont series of soils, and some volcanic tuffs that have given rise to the Butte series.

[1] See San Francisco Folio of the U. S. Geological Survey, 1914, by A. C. Lawson.

The surface soils of the Aiken series are red to orange or yellowish red in color, sometimes with brownish-red variations. The subsoil, where present, is of the same or a little lighter color, and generally is somewhat heavier in texture. The topography is sloping to hilly. Much of the land is quite steep, and drainage ranges from good to excessive. The rocks underlying these soils are, for the most part, quite hard, and bedrock occurs at depths ranging usually from 2 to 4 feet below the surface. In rare cases the bedrock lies below the 6-foot section. On the other hand, it often outcrops. The native vegetation consists of oak, fir, redwood, madroña, manzanita, chamisal, poison oak, and a great variety of chaparral. In the Healdsburg area only the loam member of this series is mapped.

The surface soils of the Olympic series are brown typically, with a somewhat reddish or chocolate-brown tint. The subsoil is generally of a somewhat lighter brown color, although the surface soil color often extends to the bedrock substratum with little change. The subsoil does not usually differ greatly from the surface soil in texture or structure. The surface is rolling to quite steep and hilly and the drainage ranges from good to excessive. These soils are residual from basic-igneous and metamorphosed rocks, including basalt, diabase, volcanic tuffs, and serpentine. In the Healdsburg area the Olympic soils are largely nonagricultural and have a fair native covering of oak, fir, laurel, madroña, and other growths. The stony loam, loam, and clay loam types are mapped.

The Altamont soils vary in color from light brown to dark brown. Rock fragments in varying amounts may occur in the soil and subsoil. The subsoil is usually of lighter color than the soil, being lighter brown or yellowish brown and usually rests upon a bedrock substratum within 6 feet of the surface, although in places the soil is much more deeply weathered. The Altamont soils occupy rolling, hilly or mountainous land, and are eroded on some of the steeper slopes, where there is abundant rock outcrop. They are well drained but are retentive of moisture. The native vegetation varies from a fair covering of timber to a thin parklike growth. The soils are derived largely from interbedded sandstones and shales. In the Healdsburg area they are apparently low in lime and organic matter, but the material is in places derived from somewhat calcareous rocks and the subsoil here is consequently calcareous. In places it is difficult to differentiate these soils from the soils of the Olympic series, which are of similar color but are derived from igneous rather than from sedimentary rocks. As mapped the Altamont soils may include some undifferentiated material belonging with the Olympic, Sites or Aiken series. The stony silty clay loam, gravelly fine sandy loam, and silty clay loam are mapped in the Healdsburg area.

The surface soils of the Sites series are red, with variations of brownish red and light red. No lime is apparent in the surface soil. The subsoil is usually lighter in color or more pronounced red than the surface soil, but may be brownish red. Samples of both soil and subsoil when air dry usually fade to a reddish-brown color. The subsoil is generally somewhat heavier than the soil and may be compact and relatively impervious. Bedrock is encountered at depths ranging from a few inches to 3 or 4 feet. The topography is rolling to quite hilly and steep. In this area the series is derived mainly from conglomerates, with only minor inclusions of fine sandstones and shales. The land supports a dense cover of large fir, oak, madroña, laurel, and other vegetation. The Sites soils are similar to the Corning soils in color and general appearances, and in places they are differentiated with difficulty. Besides being derived, however, from consolidated rocks rather than from unconsolidated material, as are the Corning soils, they differ in topography, there being no indication of terraces. The subsoil of the Sites gravelly loam, the only type mapped, is not so heavy as the Corning subsoil, and the substratum, where accessible, is plainly different. The Sites gravelly loam in this area is somewhat deeper than typical.

The soil of the Butte series is gray or brownish gray in color and may extend to bedrock with little change. The distinct subsoil that occurs in places has usually a little lighter color than the surface material. It rests upon the parent rock at any depth from a few inches to several feet and grades into it through a zone of partially disintegrated rock material. The surface is rolling to hilly, and drainage is good. The Butte loam, the only type mapped in this area, is derived from gray, tufaceous volcanic rocks.

The soils of the Goldridge series are gray or brownish gray, with a grayish-yellow to yellow subsoil. This is typically of heavier texture than the soil, has a compact structure, and rests upon bedrock usually within the 6-foot section. The surface is smoothly rolling. Drainage is generally well developed, but subdrainage is somewhat retarded by the comparatively heavy subsoil. The Goldridge series is derived from a very soft, fine-grained sandstone. It has not been previously recognized, although some of the grayish variations occurring in the Altamont soils in the San Francisco Bay region would probably now be correlated as Goldridge material. Only one type, the fine sandy loam, is encountered in the Healdsburg area.

SOILS DERIVED FROM OLD VALLEY-FILLING MATERIAL.

Subsequently to the time when the rocks giving rise to the residual soils of the area were formed, the general level of the land was much lower than it is at present. During this time erosion brought a great deal of material from the hills into what are now the valleys.

The coarser particles were dropped near their source, while the finer materials, the silts and clays, were deposited near the centers of the basins. Later the land was elevated and the deposits were brought above the plane of sedimentation. They have since been eroded and weathered and subjected to leaching and in places have been modified or reworked a number of times by alluvial agencies so that some of the deposits are younger than others. They have all, however, lain in their present position so long that they have undergone alteration, which is manifested in a leached and altered surface soil, a heavier subsoil resulting from the working downward of the finer particles from the surface, and in some cases a hardpan. The soils of this origin are classed under the group of old valley-filling soils. In this group are the Fresno series, consisting of gray soils with a hardpan; the Madera series, including brown soils with a hardpan; the Corning series, made up of red soils; the Pleasanton series, of brown to dark-brown soils; and the Pinole series, consisting of yellowish-brown to yellow soils. The Corning, Pleasanton, and Pinole soils are without true hardpan.

The soils of the Fresno series as typically developed in previous surveys are of light-gray or gray to light brownish gray color, with grayish-brown to light-brown variations. The subsoils are of similar color. They generally are heavier and more compact and contain a gray hardpan of variable thickness and hardness. This may or may not be calcareous and may appear as successive thin sheets or layers, a few inches thick, separated by friable material. The series generally occurs as remnants of extensive alluvial fans occupying level to undulating or slightly irregular valley plains. In the Healdsburg area the Fresno soils differ in subsoil and hardpan characteristics from their typical occurrences in the interior regions of the State, They are underlain by a grayish-brown to gray or yellowish hardpan which may be several feet thick. This hardpan sometimes has lime coatings or seams, but in the main it can not be called a lime hardpan, as it usually does not contain enough lime to effervesce with cold dilute hydrochloric acid. Occasional black coatings occur which appear to be caused by iron precipitates. This hardpan, which occurs under most of the soils, consists of clays, silts, and sands cemented with a fair degree of hardness and often interbedded with uncemented beds. It has been observed extending to depths of 2 to 4 feet, and in at least one place is 8 feet deep. It softens considerably during the rainy season, but at all times is a barrier to the passage of water or roots. Occasionally it does not occur within the 6-foot section, but here its place is taken by gray to brown, tenacious, stiff clay which is nearly as impervious.

Where the soils of this series are terminated by a bluff and give way to alluvial soils, the soil on the bluff and for a few rods back

lacks the hardpan and often the stiff subsoil, and is consequently much more desirable. The topography of the Fresno soils may be level or rolling. The surface is usually marked by scattered low mounds. The land has a natural parklike appearance. Much of the soil lies so low that erosion is not serious. The beds of clay and silt are evidence that some of the material was laid down in quiet waters, while the beds of coarse sand and gravel encountered in places indicate deposition by swift-moving water. Apparently the material has been derived from a great variety of rocks. The soil material appears to be much older than that giving rise to the Corning, Pleasanton, and Pinole series. The Fresno soils differ from the Madera in degree of alteration rather than in character. These two series of soils merge into each other and were apparently formed at the same time and by the same agencies. The Madera soils are deeper and the hardpan in their subsoils is thinner and more often lacking. In the Healdsburg area the Fresno gravelly fine sandy loam and loam are mapped.

The soils of the Madera series range from light brown to dark brown. The subsoils are generally of somewhat heavier texture and of compact structure. They are similar to the soils in color, or slightly lighter brown, and have a brown to grayish-brown or yellowish-brown hardpan. This is typically noncalcareous, but calcareous seams and incrustations frequently occur and in places the hardpan is markedly calcareous. The Madera series in this area departs to a considerable extent from its typical development elsewhere, being less well defined and subject to local variations. It is probably derived largely from material originating in sedimentary rocks. The surface soil here is brown or grayish brown in color. The surface soils, subsoil, and hardpan are subject to considerable variation in arrangement and thickness, but the surface soil and subsoil together average about 36 inches in depth. In places the subsoil constitutes but a thin layer resting upon the hardpan. The latter varies from a layer a few inches thick, distinctly cemented and impenetrable to thicker layers of less firmly cemented material. A deeper, more friable substratum usually extends to a depth of 72 inches or more. The surface is uneven, owing to hummocks and minor depressions, but in general the series occupies a sloping or nearly level surface slightly elevated above the recent-alluvial soils. Drainage is inadequate during the rainy season, owing both to the depressions and to the compact subsoil which retards percolation. The only Madera soil encountered in this survey is the loam.

The Corning series includes types with a pale-red, red or orange-colored soil sometimes brown or yellow. The subsoil is red to pale red or yellowish red in color and heavier in texture than the surface soil. The soil is generally easily puddled and boggy when

wet. It is deficient in organic matter and lime. A substratum is encountered at a depth of 4 to 8 feet below the surface. It consists of stratified beds of cobbles, gravel, sands, and finer materials which are compact and sometimes partially cemented. These soils usually occupy regions of intermediate elevation along the valley margins, flanked on their upper side by the residual soils from consolidated rocks and on the lower by recent alluvium. The material has lain in its present position so long that a distinct subsoil has been formed. The soils occupy very gently sloping to rolling terraces or benches and occasional high, dissected areas. The native vegetation consists of several species of white, black, and live oak, Douglas fir, and a few pines, with redwood, madroña, manzanita, and various small trees and bushes. In general the native growth is dense. In this survey the Corning gravelly loam and loam types are mapped.

The surface soils of the types included in the Pleasanton series range in color from medium brown to dark grayish brown. The subsoil is somewhat lighter brown, typically compact and heavier than the surface soil, and rests upon a compact substratum consisting of rounded gravel in a matrix of fine soil material and only slightly cemented. No lime nodules or concentrations are apparent in the surface soil or subsoil. The Pleasanton series in this area differs from the typical in that the subsoil has much the same texture as the surface soil. It is friable and as permeable to water and plant roots as the surface soil. The substratum differs from typical in containing many beds of fine sand and silt that contain no gravel. The Pleasanton series occurs on terraces which in this area are lower and more recent than those on which the Corning soils are encountered. The terraces are either level or have been molded by erosion into low, gentle hills. They were originally covered with a good growth of oaks of various species, fir, redwood, madroña, and less important growths. Only the gravelly sandy loam type of the series is encountered in the Healdsburg area.

The surface soils of the Pinole series are light yellowish brown or yellow to light grayish brown. The subsoil is similar or heavier in texture, but somewhat lighter in color. It shows considerable yellow and includes a mixture of yellow and gray with a little brown. It is underlain at varying depths below 6 feet by a substratum consisting of interbedded layers of clay, silt, and fine sand, with a few beds of gravel. All these beds are partially cemented and the seams in the clay and silt beds show occasional coatings of lime. This material is not very hard, but it is sufficiently compact to stand in perpendicular banks for some time. The color of the substratum varies from dull yellow to light brown and drab gray. The Pinole soils occur on remnants of terraces and are mainly level or gently rolling. They

include, however, some high, badly eroded land. They were originally densely covered with Douglas fir, several species of oak, madroña, manzanita, and other growths. The gravel occurring in most of the soils consists of brown or grayish-brown sandstone, shale, and chert. Many of the rocks show seams of quartz, and quartz pebbles are often encountered. The soils show indications of being neutral or mildly acid. This series is not as important in the present survey as in the Ukiah area, which adjoins this area on the north. Only one type, the gravelly loam, is mapped.

SOILS DERIVED FROM RECENT ALLUVIUM.

Since the valleys were raised to their present elevation there has been a continual deposition of sediments on their floor by all the streams that enter them from the hills. These later deposits have undergone no pronounced change from weathering, such as the development of a hardpan or consistently heavier subsoil; the heavier subsoil occasionally encountered consisting of originally finer deposits. The soils may show abrupt variations in texture at different depths. All the recent-alluvial soils except the Honcut have been formed from a mixture of materials coming from all kinds of rocks. The Honcut soil in this survey can be traced to material washed from the Aiken soils, which are derived from basic igneous rocks. The other recent-alluvial soils are the Yolo, which are brown; the Tehama, light brown or yellowish brown; and the Dublin, dark gray to black in color.

The surface soil of the types included in the Honcut series is typically brown to reddish brown. The subsoil is similar in color to the surface soil and not characteristically heavier in texture, though irregularly stratified sediments of variable texture may occur. These soils occupy alluvial fans and stream bottoms where the material has been deposited by small streams. The topography is gently sloping to nearly level and the surface is smooth. In this area the series includes material of reddish-brown to dark-red color and having in places a heavier subsoil. This soil, if more extensive, would probably be recognized as a distinct series. It differs from the Corning soils, which are also red, in subsoil conditions and in the lower position and less eroded surface. Only one Honcut soil, the gravelly loam, is recognized in the Healdsburg area.

The Yolo series includes types with brown to dark grayish brown surface soils and subsoils of similar or lighter texture and slightly lighter color. The soil and subsoil is usually friable and open, except in the heavier types, but may pass into compact gravelly material at 4 to 6 feet below the surface. The soil usually contains considerable organic matter. Types of this series occur on recent alluvial fans, stream flood plains, and low terraces. They are derived from materials coming from a wide range of rocks, in which sedimentary

and metamorphosed sedimentary formations seem to predominate. The topography is gently sloping to nearly level. The steeper part of the fans occurs next to the hills, their outer margins being more nearly level. In the Yolo series as mapped in some other areas the included alluvial-fan and flood-plain soils have not been differentiated, but in this area the fans and flood plains are distinct enough to be separated, and stream-bottom phases are shown on the accompanying map. These phases occur along the Russian River and its largest tributaries. These are perennial streams and overflow their bottoms annually. The types mapped are the gravelly loam, fine sandy loam, loam, silt loam, and silty clay loam. They include smaller areas of soils having a rather pronounced grayish color, particularly under dry field conditions. Such soils are not typical of the Yolo series. In some instances the subsoil in these grayish variations is heavy and compact and appears to approach the subsoil conditions encountered in the older valley-filling deposits.

The Tehama series has light yellowish brown to yellow or light grayish brown surface soils, with somewhat lighter colored subsoils, mainly grayish or brownish yellow. The topography is gently sloping to nearly level. The Tehama soils occur on alluvial fans and have been deposited by small intermittent streams. The material has apparently been derived from the unchanged and the metamorphosed sedimentary rocks. The lighter color of the Tehama soils as compared with the Yolo is apparently in part due to a smaller content of organic matter, but it may also be due in part to original differences in material. As mapped in this area the Tehama soils have the same origin and mode of formation as the Yolo soils but differ from them in having a lighter color. Some small areas, of Yolo material, have not been separated from the Tehama. The Tehama soils mapped are the gravelly loam and loam.

The surface soil of the types included in the Dublin series is dark gray to black in color. The subsoil is usually lighter in texture than the surface soil and dull yellow, yellowish gray or grayish brown in color. There is no uniformity in color or texture of the subsoil and substratum. These consist of alternate layers of clay, silt, and loam, with an occasional bed of gravel as lower depths are reached, the strata varying in color from black to grayish brown or yellowish gray. The soil has a rather high organic content and the subsoil shows calcareous tendencies. The topography of these soils is level, basinlike or gently sloping. In this area the native vegetation has largely disappeared, but in many cases it was herbaceous. In other places there was apparently a mixed forest growth. Some of the Dublin soils occur on typical alluvial fans and others occupy shallow basins, consisting evidently of deposits from quiet waters. They are derived apparently from sedimentary rocks, but as mapped include some material from

various other rock sources. They apparently owe their black color to their lime and organic-matter content. In the Healdsburg area the Dublin loam, clay loam, and clay adobe are mapped.

In addition to the recent-alluvial soils mentioned, Riverwash, a nonagricultural type, is mapped along the larger streams.

The following table gives the actual and relative extent of the several soil types. Their distribution over the area is shown by means of colors on the accompanying map.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough mountainous land	70,976	31.8	Yolo loam	2,496	1.7
Goldridge fine sandy loam	28,480	12.8	Stream-bottom phase	1,216	
Madera loam	14,656	6.6	Dublin clay loam	2,944	1.3
Fresno loam	10,880	4.9	Aiken loam	2,496	1.1
Yolo silt loam	2,624	4.1	Pinole gravelly loam	2,496	1.1
Stream-bottom phase	6,528		Tehama gravelly loam	2,176	1.0
Corning gravelly loam	8,000	3.6	Pleasanton gravelly sandy loam	2,112	.9
Altamont silty clay loam	7,680	3.4	Olympic loam	1,792	.8
Yolo fine sandy loam	3,328	3.2	Tehama loam	1,728	.8
Stream-bottom phase	3,712		Dublin loam	1,344	.7
Sites gravelly loam	6,976	3.1	Light phase	320	
Riverwash	6,528	2.9	Altamont stony silty clay loam	1,408	.6
Fresno gravelly fine sandy loam	5,120	2.8	Dublin clay adobe	1,280	.6
Eroded phase	1,088		Corning loam	1,152	.5
Olympic stony loam	5,952	2.7	Olympic clay loam	832	.5
Yolo gravelly loam	3,520	2.2	Dark heavy phase	192	
Stream-bottom phase	1,280		Butte loam	576	.3
Yolo silty clay loam	3,648	2.0	Honcut gravelly loam	576	.3
Stream-bottom phase	896				
Altamont gravelly fine sandy loam	3,840	1.7	Total	222,720	

AIKEN LOAM.

The soil of the Aiken loam is a red or yellowish-red to dark red loam ranging ordinarily from 1 to 2 feet deep, but in places reaching a depth of 4 feet. It is friable and easy to cultivate. It has a varying content of angular rock fragments, but these typically are not abundant enough seriously to affect cultivation. The subsoil where present is usually a clay loam extending to the bedrock. It is generally light red or yellow in color, but may be red, grading yellower with depth. The bedrock in places lies directly beneath the surface soil, and it usually occurs within a depth of 4 feet. It is a fine-grained, apparently metamorphosed, basic igneous rock, and shows some schistose structure.

This is a widely distributed type. It occurs in small bodies and narrow strips on the lower slopes of the hills, bordering the floors of

the valleys and in comparatively level places back in the hills. A large acreage is mapped in the hills west of Dry Creek Valley. In patches of 1 or 2 acres in some of the bodies in Dry Creek Valley the soil is a clay loam or clay, occasionally with a quite pronounced adobe structure. Many bodies of the Aiken loam too small to map occur in the hills. The type often includes some foot-slope material on the lower slopes and on the upper margins merges with Rough mountainous land. Its surface ranges from sloping to steep. It is all tillable, but some of the land is so steep that it can be cultivated only with difficulty. Drainage is excessive and erosion is active.

Much of this soil has been cleared and set to fruit, among which are grapes and prunes. The type is very productive. Grain does well. Some of the areas of the type are used mostly for pasture. The type often occurs in small, unfavorably situated bodies, and it is in many places comparatively inaccessible.

As mapped in this survey this type includes a stony variation which is indicated on the map by stone symbols. The soil in such areas consists of a red or brownish-red loam containing a high percentage of angular fragments of the parent rock. The stones gradually become larger with depth, and bedrock is reached between 2 and 6 feet below the surface. The soil is friable, but rather difficult to cultivate owing to the large content of stones and the steep topography. This stony soil occurs in a few small bodies scattered along the east side of the area in the hills. The topography is steep to hilly, erosion is active, and drainage is excessive. This variation is mostly devoted to vineyards, which do well.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Aiken loam:

Mechanical analyses of the Aiken loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573038.....	Soil.....	3.8	8.4	4.8	18.4	13.6	34.8	16.4
573039.....	Subsoil.....	2.8	6.0	3.6	15.6	13.2	36.0	[illegible]

OLYMPIC STONY LOAM.

The soil of the Olympic stony loam typically consists of a brown loam, carrying a considerable quantity of rock fragments. The parent bedrock usually lies between 1 and 3 feet of the surface and rock outcrop is abundant. The soil for the most part is quite shallow, and usually there is no true subsoil. Where a distinctive subsoil occurs it is lighter in color and heavier in texture than the soil.

There is considerable variation in the texture and color of the soil. The texture in places is a clay loam or clay and the color in occasional

spots is red or gray. The included gray material probably represents a soil of the Butte series and the red one of the Aiken types. The gray soil comes from tufaceous rock but occurs in bodies too small to map.

The Olympic stony loam occurs in numerous bodies of fair size on the hills bordering the more level parts of the valleys from Cloverdale to the extreme southern limits of the area. It occupies rolling to steep hillsides, often broken by precipitous ravines. Drainage is excessive and erosion active.

The type is used almost entirely for pasture, but occasional slopes and flatter areas are cultivated. Where the soil is of good depth, it is apparently quite productive. Grain hay is the leading crop.

OLYMPIC LOAM.

The Olympic loam consists of a brown or slightly reddish brown friable loam, rather free from rock fragments. The soil material is usually not very deep. The surface soil may extend without change to the bedrock or may be underlain by a lighter colored subsoil of the same or a little heavier texture. The depth to the rock varies greatly. Over considerable areas it is not more than 10 inches below the surface, and it usually occurs within a depth of 3 feet.

As mapped the type includes some yellow soil. This probably represents materials of the related Brownsboro series which is of similar origin.

Two fair-sized bodies of the Olympic loam are mapped west of the Russian River, about 6 miles south of Healdsburg and another near Forestville. Two small bodies occur south of Asti, one east of Healdsburg, and one east of the Oriental School. The type occurs in other small isolated bodies. It has a rolling topography. Drainage is excessive and erosion is active. The type is mostly used for pasture. Part of it is cultivated and on this part grain, grain hay, and grapes give fair returns.

OLYMPIC CLAY LOAM.

The Olympic clay loam consists of a brown clay loam, averaging 12 inches deep. The subsoil where present is a little lighter in color than the soil and usually a little heavier in texture, but it may be displaced by the parent bedrock which is encountered at a few inches to 3 or 4 feet below the surface.

This is a type of very small extent. Several bodies occur in the hills east and southeast of Healdsburg, and two bodies of fair size are mapped west of the Russian River, northwest of Trenton Station. The type occupies smoothly rolling to smooth hilly land. Drainage is thorough and erosion is quite active. Most of the type is used for pasture, but a part is cropped to grain hay. Some fruit trees and

vines have been set out and where the soil is of good depth they do very well.

Olympic clay loam, dark heavy phase.—As mapped in this survey the Olympic clay loam includes minor areas of dark-colored or black soil of heavy texture which is differentiated upon the map as a dark heavy phase. This soil really represents types of the Climax series which is in origin similar to the Olympic soils. The dark, heavy phase consists of a dark-gray to black clay which is very sticky and adhesive when wet. It bakes hard when dry and cracks to a certain extent, sometimes approaching an adobe structure. It is quite high in organic matter and apparently in lime. Below the depth of 12 to 18 inches a subsoil of grayish-yellow or yellowish-brown clay occurs. This usually passes into the bedrock between the depth of 18 inches and 6 feet. This phase is mapped in a few small bodies east of the Russian River opposite Geyserville and Asti, where it occupies the lower slopes of hills. The surface is smoothly sloping to nearly level. Drainage is fair and erosion moderate. Most of this soil is in pasture. A small acreage is devoted to grain. The yields are fair. It is difficult to keep the soil in good tilth.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Olympic clay loam and of the soil of its dark heavy phase.

Mechanical analyses of Olympic clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573932	Soil	3.0	4.6	2.6	12.0	15.0	37.3	25.5
573933	Subsoil	1.4	4.4	2.3	11.6	14.6	34.6	30.8
Dark heavy phase:								
573952	Soil	2.6	5.6	2.8	11.8	13.2	25.5	38.6

SITES GRAVELLY LOAM.

The surface soil of the Sites gravelly loam in general consists of a dull-red loam containing many rounded cobbles 1 to 3 inches in diameter. It varies from 1 to 2 feet in depth and grades into a slightly heavier subsoil which is usually yellower than the soil. The color, however, is variable and may be yellow, red, yellowish brown or grayish yellow. The soil is friable and easy to cultivate, though it contains only moderate quantities of organic matter. It varies considerably in color, being in places brownish red, in others pale yellowish red, and occasionally bright red. Air-dry samples or dry field surfaces usually have a reddish-brown color. As mapped in

this survey some brown material of the Altamont series may locally be included, as well as small bodies of Corning soils.

The subsoil is underlain by the parent bedrock, but as the rock weathers readily and deeply it seldom outcrops and often occurs below the 6-foot section. It is mainly a conglomerate, consisting of rounded cobbles, many of which are sandstone embedded in a mass of fine material. Many of the cobbles contained in the soil are weathered and crumble readily. In a few places the parent rock is a fine-grained sandstone or shale, but this is interbedded with the conglomerate and the materials from the two rocks are intimately mixed.

The Sites gravelly loam occurs on the high ridge that separates Dry Creek Valley from the Russian River Valley. The topography varies from that of rolling hills on the border, which may be cultivated without great difficulty, to higher and steeper hills in the center of the divide. These would be very difficult to cultivate except on the gentle slopes and the rounded hilltops. Some of the ravines have steep slopes. Drainage is good to excessive, and the control of erosion is a factor in farm management. No concentration of lime is apparent in the soil, which, however, gives no evidence of being acid.

Some of the lower hills and more gentle slopes occupied by this soil have been cleared and set to grapes. Except for the extra cost of cultivation, due to the unfavorable topography, the type seems well suited to this crop. The yields range from fair to large and the quality of fruit is good. One grower, who has an orchard of Imperial prunes, states that the soil is especially suited to this crop. The greater part of the type is still uncleared. The density and fine upright growth of the native forest would seem to indicate that the soil is well suited to tree growth.

ALTAMONT STONY SILTY CLAY LOAM.

The Altamont stony silty clay loam in general consists of a brown or yellowish-brown, in places reddish-brown, silty clay loam containing a high percentage of rock fragments. It is shallow, the plow occasionally striking bedrock, though in places the rock lies 12 to 24 inches below the surface. The rock fragments vary somewhat, but in the main consist of soft, fine-grained brown sandstone. Occasionally the stone is harder. There is usually no distinctive subsoil, the soil passing directly into the more or less disintegrated rock. Often at 6 to 8 feet below the surface the rock is so soft that it can be crushed with the fingers, and it is easily penetrated by water and roots.

This is an unimportant type. It is indicated on the soil map by stone symbols in Altamont silty clay loam color. Small bodies occur north and south of Cloverdale, west of Graton, at Korbel, and across the river to the south. In these last-named bodies the soil is a little

VIEW FROM HILLS ONE-FOURTH MILE NORTH OF FAUGHT'S CEMETERY LOOKING WEST.

Orchards and vineyards on Yolo gravelly loam in foreground. Beyond this occur the soils of the Dublin series. The Valley plain in the distance, with the scattered growth of valley oaks, is occupied by the Fresno loam.

VIEW NEAR HEALDSBURG, SHOWING ALLUVIAL VALLEY OF THE RUSSIAN RIVER.

The crops on stream-bottom phases of the Yolo silt loam and Yolo fine sandy loam are French prunes, alfalfa, and hops. Fitch Mountain in distance.

FRENCH PRUNES GROWING ON THE STREAM-BOTTOM PHASE OF THE YOLO SILT LOAM, NEAR HEALDSBURG.

deeper than typical and correspondingly more desirable. Rounded cobbles, which are evidently remnants of old valley-filling material giving rise to the Corning soils, occur here, but the soil in the main is residual. There is some development of a yellowish subsoil in these bodies.

The Altamont stony silty clay loam occupies rolling to steep hillsides. Owing to the softness of the rock, outcrops are rare and the hills are usually rounded. Some of the type is cultivated to grain, but its productiveness is low. Grapes are grown to some extent, but the returns are low except on the areas at Korbel, on which grapes do very well.

ALTAMONT GRAVELLY FINE SANDY LOAM.

The Altamont gravelly fine sandy loam consists of a brown or grayish-brown fine sandy loam about 12 inches deep, containing a large proportion of gravel and cobbles. It is friable and easy to cultivate, though rather low in organic matter. The subsoil is usually a dull-red to brown clay loam, extending to a depth of 2 to 4 feet. The bedrock consists of yellowish-red or brown, feebly cemented, stratified beds of silt, clay or fine sand. Some of these beds contain considerable gravel. On the steepest hillsides the subsoil is exposed, and gives rise to reddish-brown or red spots in the soil.

A large body of the Altamont gravelly fine sandy loam extends north from Sebastopol west of the Laguna de Santa Rosa. Others occur south and southeast of Sebastopol. The type is closely associated with the areas of Goldridge fine sandy loam, and seems to be derived from the same series of soft rocks, the gravelly beds producing the gravelly loam and the sandy beds the fine sandy loam.

The topography varies from sloping to rolling. The type usually lies higher than the adjacent Goldridge fine sandy loam. Surface drainage is thorough, and erosion has to be guarded against. Subdrainage is rather deficient.

This type occurs in a noted orchard district, and practically all of it is in fruit, chiefly apples, peaches, prunes, cherries, and grapes. It is a profitable soil for these fruits, but is less desirable than the Goldridge fine sandy loam, which is the principal type in this district.

In the table below are given the results of mechanical analyses of samples of the soil and subsoil of the Altamont gravelly fine sandy loam:

Mechanical analyses of Altamont gravelly fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
57360.....	Soil.....	1.8	1.5	0.9	37.6	23.1	22.2	12.8
57362.....	Subsoil.....	.4	.3	.3	27.0	20.1	21.3	30.2

THE ALTAMONT SILTY CLAY LOAM.

The Altamont silty clay loam typically consists of a brown or light-brown silty clay loam of rather light texture containing few or no fragments of the parent rock. It is friable and easy to cultivate, though low in organic matter. At 8 to 16 inches it grades typically into the subsoil, which is usually lighter brown or more yellowish brown than the surface soil and becomes heavier in texture with depth. The depth to bedrock is variable but usually not greater than 6 feet. In places there is no distinctive subsoil, and the bedrock may occur within a foot of the surface. Occasionally it outcrops. It usually consists of shattered and weathered sandstones and shales which allow more or less ready passage of water and roots.

Areas of this type are scattered throughout the survey, from a point near Cloverdale southward to its southern limits. They occupy hills bordering the more level parts of the valleys. Other areas occur west of Forestville and on the high ridges extending southeast of Healdsburg to the vicinity of the Hill School.

The type is encountered on rolling to steep hills. Drainage is well to excessively developed and in places erosion is active.

This type varies considerably from place to place in agricultural value, owing to variations in topography and depth of soil. The areas near Asti and Cloverdale are shallow and in part steep. Those on the ridge southeast of Healdsburg and in the vicinity of Hill School are deeper, have a more even topography, and form better agricultural land.

On the more gentle slopes and flatter hilltops the type has considerable agricultural value and is in many places cultivated. Grain and grapes, the leading crops, have been only moderately profitable in the shallower areas and in some cases cultivated fields have been abandoned. The smoother slopes where the soil is deeper are successfully used for grain hay. Some prune orchards and vineyards are being set out and give good promise of success. The steeper slopes are in pasture. Valley oak, live oak, buckeye, laurel, and fir grow in the ravines and to a very small extent on the hilltops.

In the following table are given the average results of mechanical analyses of samples of the soil and subsoil of the Altamont silty clay loam.

Mechanical analyses of Altamont silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573936, 573976.....	Soil.....	0.7	3.1	1.4	4.8	12.2	54.5	23.0
573937, 573977.....	Subsoil.....	.6	3.8	1.9	5.3	11.5	45.6	30.4

BUTTE LOAM.

The soil of the Butte loam is a gray or brownish-gray, rather friable loam. A well-defined subsoil may occur in places. It is usually a little lighter colored than the surface soil. The parent rock lies at any depth between a few inches and several feet. A zone of partially disintegrated material lies between the soil and the solid rock. The soil is usually low in organic matter and somewhat deficient in power to retain water.

The Butte loam in places resembles the Fresno soils, which are of similar color but are derived from unconsolidated old valley-filling material. Both these soils occur on the lower foothills of the Coast Ranges, and as mapped the Butte loam may include locally some areas of soils of the Fresno series.

The Butte loam is of very small extent. It occurs in one small area east of the Lytton School and in two others in the vicinity of Maacama School. Another body occurs northeast of Forestville. The type is rolling to hilly in topography, and drainage is well established. Erosion is rather active. The land is used for pasture. There is a scattered growth of oak and small brush over most of it. A large part of the type could be cultivated, but the shallowness of the soil and its low content of organic matter indicate a relatively low agricultural value.

In the table following the results of mechanical analyses of samples of the soil and subsoil of the Butte loam are given:

Mechanical analyses of Butte loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573963	Soil	0.2	2.2	2.4	25.0	21.4	34.6	10.1
573964	Subsoil	6.0	14.0	5.1	15.0	14.6	34.9	7.7

GOLDRIDGE FINE SANDY LOAM.

The soil of the Goldridge fine sandy loam is typically a gray or brownish-gray fine sandy loam, 12 to 30 inches deep. It is loose and friable and easy to cultivate. It has only a fair supply of organic matter. No concentrations of lime are apparent and the soil in the field gives indications of being neutral or slightly acid. The subsoil usually is a loam or clay loam of friable structure and yellow or grayish-yellow color. In places, however, it is a fine sandy loam, somewhat heavier and more compact than the surface soil. It extends to the bedrock, which lies from 3 to 8 feet below the surface.

The rock giving rise to this soil is a yellow, feebly cemented, fine-grained sandstone. It is soft enough to be crushed readily, but firm enough to stand in perpendicular banks for years without caving. It offers little resistance to the movement of water, and roots pass through it readily. The rock is not calcareous, but it contains considerable quantities of iron, iron stains and iron concretions being common.

A large tract of this soil forms what is known as the Goldridge district west and northwest and south and southwest of Sebastopol. It extends southward from Trenton to the limits of the area and westward from the Laguna de Santa Rosa to the boundary of the area and probably beyond.

The small detached body of this soil north of Trenton seems to have come from a rock somewhat different from that which has given rise to the greater part of the type. The rock here is in part a hard, flinty sandstone containing shells. Some of the beds are apparently a gray volcanic tuff. Others are fine-grained sandstones very similar to the typical rock.

The type has a rolling topography. In the northern and eastern parts of the area the hills are not high nor the slopes steep and the type is all tillable. In the southern and western parts the elevation is greater and the hills are steeper and many of the slopes are too steep to cultivate. Erosion has to be guarded against in tilling all areas of this soil, and it is a serious problem on the steeper slopes. Seepage and springs cause many small wet places on hillsides.

This type was originally covered with a dense growth of timber, except in the southern part of the area nearer the coast, where many of the exposed hillsides were bare. The native timber varies in different parts of the area. In places it consists of redwoods, with little smaller growth, and in other places of nearly pure Douglas fir, with a few oaks and shrubs. In some places the timber was mostly oak of several species, with madroña, manzanita, and smaller plants in the undergrowth.

The Goldridge fine sandy loam is an extremely valuable soil. It has been found especially well suited to many fruits, in addition to grain, grass, and potatoes. The most extensively grown fruits are apples, cherries (both sour and sweet), prunes, plums, pears, peaches, grapes, and brambleberries. All these fruits do well. The type is markedly uniform in texture and general characteristics over its whole extent, but varies somewhat in depth to subsoil and bedrock and in their composition. Orchardists find many local differences in crop adaptations as a result of these slight variations. The Gravenstein is the favorite variety of apple, as it matures early and usually

finds a good market. It is customary to grow blackberries or loganberries between the rows of young trees. These crops are profitable in themselves. The small area of the type north of Trenton is mostly in vineyards, which are fairly successful.

The marked adaptation of this soil to fruit crops is probably due to the excellent texture, structure, and depth of the surface soil; to the good water-holding capacity of the subsoil and substratum, and to the permeability of the subsoil and substratum to roots.

The vineyards on this soil are as yet free from phylloxera and it has not been found necessary to use vines grafted on resistant stocks.

The adaptation of the areas of this type for orchard fruits in the extreme southwestern part of the area diminishes rapidly as the coast is approached. The few orchards there are stunted and the yields are low. The fruit is small and inferior. This is apparently due to unfavorable climatic conditions, strong breezes from the sea, which is only 8 to 10 miles away, sweeping over the hills. In their original state these hills were largely bare of tree growth and under cultivation it is found that fruit trees do well only on the sheltered sides of the hills. In this part of the area the type is largely devoted to grain and potatoes, the latter crop being grown here extensively.

In the southern part of the large body of Goldridge fine sandy loam there are some beds of tufaceous material. These beds, which as seen in exposures are about 15 feet thick, have the characteristic, fine-grained, yellow sandstone both above and below them. The material is apparently a gray volcanic tuff. It is sufficiently indurated to be used for building, although rather soft for this purpose. In a few places it lies so near the surface that it affects the agricultural value of the land. This variation in the character of the substratum occurs most conspicuously in two localities near the Burnside School. One area extends for a distance of about one-half mile west from the school with a width of one-eighth to one-fourth mile and the other extends in a north-and-south direction about one-half mile east of the Burnside School. In these places the depth of surface soil and subsoil ranges from only a few inches to 2 or 3 feet. Otherwise the soil is similar to the typical Goldridge fine sandy loam.

This Goldridge fine sandy loam, in certain places, particularly north and south of Sebastopol and in the hills that border the Laguna de Santa Rosa on the west, includes bodies of soil of somewhat brown color and resembling the Altamont types, and some true Altamont material is probably included with the Goldridge type as mapped. This brown soil is probably somewhat shallower and not quite so desirable for fruit culture as the typical Goldridge fine sandy loam.

In the following table are given the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the typical Goldridge fine sandy loam:

Mechanical analyses of Goldridge fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573905	Soil	0.0	[illegible]	0.3	45.7	26.6	19.2	[illegible]
573906	Subsoil	.0	.1	.2	[illegible].1	29.2	[illegible].0	26.4
573907	Lower subsoil.	.0	.1	.0	[illegible].1	17.2	20.1	13.5

FRESNO GRAVELLY FINE SANDY LOAM.

The soil of the typical Fresno gravelly fine sandy loam is a gray to light brownish gray fine sandy loam, containing a relatively large proportion of very fine sand and considerable gravel and little organic matter. The type as mapped includes some material of loam texture. The soil extends to depths of 12 to 20 inches and rests on a subsoil of gray, grayish-brown or brownish-gray clay loam or clay, often extending to great depth, cuts in hillsides showing beds of gray clay 50 feet deep. In many places beds of hardpan from 1 foot to 5 feet or more thick are encountered at depths ranging from 12 to 24 inches below the surface. These beds consist of cemented layers of gray or brown to yellowish, rather coarse material. The hardpan outcrops in many places on eroded hillsides and hilltops.

This soil occurs on low rolling hills lying above the floor of the eastern side of the valley and extending from a point a short distance south of Healdsburg nearly to Santa Rosa. It is also mapped on a ong ridge southwest of Windsor, which forms a bluff on the east side of the Russian River. Small bodies occur farther north, one near Lytton School and two farther west.

The topography is rolling. Drainage is well established and erosion is active. The type is used as pasture land and for grain farming. It furnishes fair pasturage, but gives low yields of grain. A few vineyards have been set out, but the type seems poorly adapted to fruit.

Fresno gravelly fine sandy loam, eroded phase.—The eroded phase of the Fresno gravelly fine sandy loam is of the same general character as the typical soil, but has a much more hilly, steep, and eroded topography. The phase is confined to a few bodies southeast of Healdsburg, situated between the lower lying areas of the typical Fresno gravelly fine sandy loam and the residual soils of the hills. The topography is unfavorable to cultivation and the land is utilized only for pasture.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Fresno gravelly fine sandy loam:

Mechanical analyses of Fresno gravelly fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573971	Soil	0.0	0.1	0.1	20.8	52.8	22.2	4.3
573972	Subsoil	12.8	11.2	4.6	16.4	12.0	27.1	15.9

FRESNO LOAM.

The surface soil of the Fresno loam is a gray to brownish-gray loam, 12 to 18 inches deep, often containing a little gravel. It contains little organic matter, is quite sticky when wet, and tends to bake when dry. The subsoil, where present, is a gray or drab, sticky heavy clay, which in a few places may extend to a depth of 6 feet or more. Under most of the soil a gray hardpan takes the place of the subsoil. The hardpan is dense enough to obstruct the passage of water and roots. The material underlying it is of the same nature as the hardpan, lacking only the cementing material. It consists of interbedded layers of clay, silt, and sand. The surface soil on some of the higher spots and on low hillocks is brown rather than gray, and represents areas of the Madera loam which it did not seem desirable to show separately. This brown soil is better drained and aerated than the typical Fresno loam and is more productive.

The Fresno loam occurs over a large plain extending interruptedly southward from a point 2 or 3 miles north of Windsor to Santa Rosa Creek. It is bounded on the west by a ridge of hills that separates it from the Russian River and farther south by the Laguna de Santa Rosa. It is bordered on the east by the recent alluvial fans and is cut in a few places by extensions of these fans that reach along the streams to the Russian River. It has a level surface marked by shallow stream channels. The surface where undisturbed is relieved by mounds 1 or 2 feet high and 10 to 30 feet across. Erosion is moderate over most of the type and the surface drainage is often rather inadequate. The internal drainage is always poor, on account of the impervious nature of the subsoil and hardpan. The type originally had, and still has over much of its area, a scattered growth of valley oak. Much of the land is used for pasture. On some ranches grain is grown and gives light yields. Grapes have been grown in some places and with a fair degree of success where the subsoil is deepest. Apples, prunes, and other fruits have been set out, but do not do well after the first year or two. On one farm, with heavy manuring

and thorough cultivation, very fair crops of fruit have been obtained, but the trees are only half as large as they should be for their age.

In the following table are given the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Fresno loam:

Mechanical analyses of Fresno loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573914.....	Soil.....	1.6	3.0	2.2	13.0	17.6	47.8	15.0
573915.....	Subsoil.....	.6	1.4	1.0	5.6	12.8	45.9	32.8
573916.....	Lower subsoil.	1.4	5.4	4.2	27.8	18.4	25.6	17.3

MADERA LOAM.

The Madera loam consists in general of a moderately friable to compact brown or grayish-brown loam, usually free from gravel and extending to an average depth of 14 inches. The soil rests upon a lighter brown, heavier textured, compact subsoil, which may extend to a depth of 6 feet or more, but usually rests at depths between 2 and 3 feet upon a rather well defined hardpan. In places a semicemented stratum may displace the hardpan layer. The subsoil and the relatively impervious layers below it retard root penetration, and water movement. The hardpan is usually gray or grayish brown, and a rather marked feature is the common occurrence of black and dark-bluish seams and coatings throughout the shrinkage checks and joints. Below the relatively impervious layer, which ranges from 1 inch to a foot or more in thickness the material is often more friable and permeable than either the subsoil or hardpan.

While the color of the soil is typically brown, there are numerous darker colored patches in the poorly drained depressions, and small bodies of the adjacent gray or brownish-gray Fresno loam, too small to show separately upon the map, are included. Some of the soil included with this type as mapped appears to be a fine sandy loam in texture, but this also was not mapped.

A large body of the Madera loam occurs on the plain between Santa Rosa and Sebastopol, while smaller bodies lie to the north nearly as far as Windsor. The surface is usually uneven, as the result of the occurrence of numerous small mounds and intervening depressions. These retain water during the rainy season, owing to the impervious subsoil and hardpan. The type lies slightly above the recent-alluvial soils. In some instances isolated bodies form slightly elevated areas in the younger Dublin and Yolo soils. The original growth on this soil consisted of grasses and scattered valley oaks.

Most of the Madera loam is used for pasture. Large dairy farms are operated on it. Grain hay is produced on included bodies of Dublin and Yolo soils and on the best and deepest areas of the Madera loam. Some ranches have been subdivided and sold in small holdings, and an attempt is being made to develop intensive agriculture. Where this soil is without hardpan, as is often the case on the marginal bodies merging into the Yolo and Dublin soils, it has been found fairly well adapted to fruit. Over much of the type, however, attempts at fruit growing have given more or less unsatisfactory results.

CORNING GRAVELLY LOAM.

The soil of the typical Corning gravelly loam is a dull-red or yellowish-red loam, containing a large amount of gravel and ranging from 12 to 36 inches deep. The subsoil is a red, pale-red or yellowish-red clay loam or clay, containing varying amounts of gravel, and is underlain at varying depths, usually below 4 feet, by a partially cemented substratum of gravelly clay. The gravel, many fragments of which are 3 or 4 inches in diameter, is composed of various kinds of igneous and hard metamorphosed sedimentary rocks. The soil is fairly easy to cultivate and is retentive of moisture.

The areas indicated on the soil map by stone symbol form a variation of the type in which there occurs a large content of rounded and subangular stones of varying size. No true subsoil is developed in these areas, the soil passing into a slightly cemented substratum of coarse cobbles and stones, with some interstitial soil material.

This stony soil occurs in a few small bodies near the Russian River, where it cuts through the highlands east of Healdsburg, near Fitch Mountain. They are sloping and rolling in topography and are well drained. Erosion is active. The land is not under cultivation, being covered with the native growth of oak and fir. It apparently has little agricultural value.

The Corning gravelly loam is a well-distributed and important type. It occurs in small to fair-sized areas on the old higher terraces of the Russian River from Cloverdale to the southern boundary of the survey. It also occurs extensively on terraces in the Dry Creek Valley. It does not occur on the plain reaching south from the Russian River to Santa Rosa.

The typical and less stony areas of the Corning gravelly loam occupy terraces or rolling hills representing remnants of terraces. Most of the bodies are well elevated above the present flood plains of the streams. Southwest of Healdsburg and north of Forest-

ville the type occurs in small bodies, evidently remnants of an old high terrace capping some of the residual hills. It is smoothly sloping to quite rolling. The areas of moderate size are not badly eroded. Most of the type has been cleared. It is esteemed for farming and especially for fruit growing. It has been set out largely to grapes, with a small acreage in prunes and apples. It seems well suited to grapes and it is probable that many other fruits will do well.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Corning gravelly loam:

Mechanical analyses of Corning gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573925	Soil	5.0	9.6	5.1	14.6	14.4	35.6	14.7
573926	Subsoil	8.4	7.0	3.8	12.6	16.1	26.8	22.3

CORNING LOAM.

The soil of the Corning loam is a red or yellowish-red loam containing a little gravel and ranging from 12 to 24 inches deep. The subsoil is a tenacious clay loam or clay, red, pale red, brownish red or yellow in color. It is underlain at depths of 4 to 8 feet by a substratum of cobbly or gravelly clay which is partially cemented and which seriously checks the passage of water and roots. The type is relatively low in organic matter and lime.

Several fair-sized areas of this soil occur in the southeastern part of Alexander Valley. Two small bodies are mapped near Healdsburg, two near Asti, one south of Cloverdale, and one east of Grant School. Three small bodies occur on the high terrace bordering Dry Creek just north of the Manzanita School.

The topography is smoothly sloping to gently rolling. Drainage is deficient in only a few places, and here the poor drainage is due to the impervious subsoil rather than to the topography.

The soil is used for the production of general farm crops and fruits. Grapes do well. Imperial prunes recently set out give every promise of success. One small area of this soil at Asti has a well-defined hardpan, and if of greater extent would be mapped as a member of a distinct series. The hardpan, which is red in color and about 18 inches thick, occurs 24 to 30 inches below the surface. It is firmly cemented. Below the hardpan to a depth of 6 feet or more there is a mottled red and yellow clay containing a little fine gravel. In other respects this soil is similar to the typical Corning loam. It is devoted to grapes, which do fairly well.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the typical Corning loam:

Mechanical analyses of Corning loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573905	Soil	5.0	7.9	5.0	14.9	17.4	34.9	15.0
573906	Subsoil	2.2	5.5	4.4	15.2	10.0	29.9	31.7

PLEASANTON GRAVELLY SANDY LOAM.

The surface soil of the Pleasanton gravelly sandy loam is a grayish-brown to dark grayish brown sandy loam containing considerable organic matter and enough waterworn gravel to affect cultivation. The subsoil below a depth of 12 to 20 inches is yellowish gray or grayish brown, several shades lighter than the surface soil. The 6-foot section of the soil usually shows several changes in color, texture, and gravel content. The gravel is usually less than 2 inches in diameter and consists of hard sandstone, shale, and igneous rocks.

Two small but important bodies of this type occur in Dry Creek Valley. Several areas occur south of Healdsburg near Grant School and west of the Russian River in this part of the survey. There are three bodies in and north of Geyserville and several in Alexander Valley.

The topography is gently sloping to smoothly rolling. The land is well drained and more or less subject to erosion. Originally it supported a good covering of mixed timber, but it has all been cleared and put under cultivation, largely to fruits, of which grapes predominate. All fruits do well. In Dry Creek Valley it has been found that the French prune grows too small to make a satisfactory commercial product, but that the Imperial or Clairac Mammoth prune does very well, and in fact much better than on the richer recent-alluvial soils where the French prune does best. On the Pleasanton gravelly sandy loam the Imperial prune has a higher percentage of sugar, dries well, and attains sufficient size to be very profitable.

Several small areas of soil included with this type east of Healdsburg and in Alexander Valley are of heavier loam texture and of lower gravel content than typical and if more extensive would be mapped separately. These areas are smoothly sloping to rolling and have good surface drainage and subdrainage. Erosion is active in places. This soil is either in pasture or devoted to grain and grapes. It gives fair yields of grain and is well suited to grapes and probably to other fruits.

In the following table are shown the results of mechanical analyses of samples of the soil and subsoil of the typical Pleasanton gravelly sandy loam:

Mechanical analyses of Pleasanton gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573023	Soil	7.7	15.6	8.8	19.2	9.8	25.5	13.5
573024	Subsoil	5.8	22.5	8.9	19.2	10.4	21.1	10.8

PINOLE GRAVELLY LOAM.

The surface soil of the Pinole gravelly loam is a yellowish-brown or grayish-yellow loam about 2 feet deep, containing a large percentage of gravel. The subsoil is very similar to the surface soil in texture and gravel content, but is generally a little lighter in color, tending more toward yellow and gray. The gravel particles in the soil and subsoil are mostly less than 1 inch in diameter. They are rounded or waterworn and consist largely of sandstone, metamorphosed sandstone, and shale. The gravel is rather unevenly distributed. In some places the content is two or three times as large as elsewhere, but in no place is gravel entirely lacking, and nowhere is it abundant enough to make the soil very leachy. Cobblestones ranging up to 6 inches in diameter occur in places, but they are relatively rare. The content of organic matter in the soil is only moderate.

As mapped the Pinole gravelly loam may include locally some undifferentiated material of the Pleasanton series.

Pinole gravelly loam is of small extent but is widely distributed. One body of fair size is mapped in Dry Creek Valley, several southeast of Geyserville, several south of Healdsburg near the Grant School, three northeast of Healdsburg, and four near Trenton.

The type in general has a stream-terrace surface, although in places it appears to consist of remnants of old alluvial fan material. It has all undergone erosion until drainage is well established and the topography varies from gently sloping to rolling or steep and dissected. The type is used either for pasture or for growing grain and grapes. Yields are only moderate. The soil seems well suited to grapes, and other fruits will probably do well where there is a favorable supply of moisture.

Part of this type on the ridge between Alexander Valley and Healdsburg has been seriously eroded, and little level land remains, the surface consisting of rolling and steep hills, some of them badly dissected by gullies. The soil section is practically the same as that of the typical Pinole gravelly loam, except that the surface soil is in places eroded away, exposing the subsoil or even the substratum.

This land is practically nonagricultural. It supports a scattered growth of oak and other trees and is used for pasture.

In the following table are shown the results of mechanical analyses of samples of the soil and subsoil of the typical Pinole gravelly loam:

Mechanical analyses of Pinole gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573961.....	Soil.....	3.4	5.4	4.0	22.2	16.0	33.4	15.6
573962.....	Subsoil.....	4.2	7.0	5.0	23.6	13.4	26.8	20.9

HONCUT GRAVELLY LOAM.

The surface soil of the Honcut gravelly loam is a dark-red or reddish-brown loam, from 18 to 24 inches deep, usually containing considerable gravel. The subsoil is very similar to the surface soil in color, but may be a gravelly clay loam in texture.

This type is of small extent. It occurs in upper Dry Creek Valley and on the west side of Dry Creek Valley. A fair-sized area is mapped 1 mile southwest of Cloverdale and another near the center of Alexander Valley. The type occupies small alluvial fans washed by intermittent streams from adjacent slopes, occupied mainly by the Aiken soils. The land was originally covered with a good growth of fir, oak, and smaller trees. Practically all this has been cleared away.

The surface is gently sloping and smooth. Most of the land is well drained, but part of it needs drainage.

The Honcut gravelly loam contains a fair proportion of organic matter, and is friable, easily cultivated, and productive. It is mostly in fruit.

The area mapped with this type on the west side of Dry Creek Valley, adjacent to the hills which border the level parts of the valley, has a low gravel content. Erosion is beginning to be active here in a few places. The soil is productive, being as desirable as the Yolo loam. It is almost entirely set out in orchards, which are doing well. Grapes, prunes, apples, plums, cherries, and pears are the principal fruits grown.

In the following table are shown the results of mechanical analyses of samples of the soil and subsoil of the typical Honcut gravelly loam:

Mechanical analyses of Honcut gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573938.....	Soil.....	0.1	1.4	1.9	19.2	21.9	26.0	19.6
573939.....	Subsoil.....	.8	3.2	2.7	13.5	19.6	36.6	22.1

YOLO GRAVELLY LOAM.

The Yolo gravelly loam consists of a brown to dark grayish brown loam, containing a large proportion of medium-sized gravel, underlain at depths of 16 to 30 inches by a brown or slightly grayish brown gravelly loam, yellowish brown in the lower depths. The subsoil usually contains more gravel than the surface soil and is often very compact at lower depths. Locally it may consist of a loam or fine sandy loam.

The gravel occurring in this soil consists of rounded, waterworn fragments and small cobbles, remnants of the harder rocks from which the soil has been derived. They are largely metamorphosed sandstone and shale. Many of these contain seams of quartz, and some are nearly pure quartz.

Areas of this type occur throughout the survey. The type is mapped in Oat Valley on the northern boundary of the area, in Dry Creek Valley, near Geyserville, in Alexander Valley, along the west side of the area south of Healdsburg, and along Mark West Creek. Small areas occur around Fulton, near the hills on the same fan, and east and north of Wright School. In many cases this type is situated on the upper part of small fans, while heavier members of the same series or of the Dublin series border it on the lower side. The type occupies smooth gentle slopes and has sufficient drainage.

This is an excellent soil for general farming. It is not well suited to hops, and the French prune does not attain sufficient size to be profitable. The Imperial prune, however, does well, and grapes, apples, and other fruits thrive.

Yolo gravelly loam, stream-bottom phase.—The soil of the stream-bottom phase is similar to the typical Yolo gravelly loam, but is more variable in texture and gravel content. It occurs in small, widely distributed bodies in Oat Valley, Dry Creek Valley, and Alexander Valley, and near Asti and Geyserville. The surface is level or marked by shallow, deserted stream channels. The streams which have formed these bodies of soil are likely at any time to encroach on them, as their channels are constantly shifting. Drainage is good, except during certain periods when the water table is near the surface. The areas are either in vineyards and orchards or are used for the production of grain. Some of the land is used as pasture. The areas vary considerably in agricultural value, with differences in texture, depth to gravel stratum, and severity of overflow. In the better areas the phase is practically as desirable as the Yolo fine sandy loam.

In Cloverdale Valley the soil of this phase is much shallower than farther south in the area. It consists of a gravelly loam, 6 to 12 inches deep, overlying pure gravel. This soil is very leachy, and grapes and tree fruits do poorly on it. The shallow nature of the

soil here is evidently due to its nearness to the gorge, through which much gravel has been washed down.

In one body of considerable extent near Preston and in two small ones east of Cloverdale the phase contains considerably more sand than typical, making it lighter in texture. The soil here consists of 10 to 36 inches of light-brown to grayish-brown sandy loam carrying a large proportion of waterworn gravel. On account of the loose, leachy texture, the agricultural value of such land is considerably lower than that of the rest of the phase. It is mostly devoted to grapes.

In the following table are shown the results of a mechanical analysis of a sample of the soil of the typical Yolo gravelly loam:

Mechanical analysis of Yolo gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
572969	Soil	4.1	5.4	3.0	15.2	17.4	40.8	14.2

YOLO FINE SANDY LOAM.

The Yolo fine sandy loam consists of a brown fine sandy loam, 12 to 20 inches deep, underlain by a subsoil of the same or a little lighter color and of similar or heavier texture. Owing to the mode of formation of this type, the subsoil varies considerably, but it is usually a fine sandy loam or silt loam.

The type as mapped includes a grayish-brown or light-colored variation which departs to a considerable extent from the typical in subsoil characteristics. It consists of a rather friable grayish-brown fine sandy loam, which may extend to a depth of 6 feet or more with little change in color or texture. Occasionally it is underlain at a depth of 12 to 30 inches by a gray to brown loam or silty loam. The soil in most places contains a little gravel. It seems to be low in organic matter and somewhat deficient in power to retain moisture.

Practically all the typical Yolo fine sandy loam borders the small streams that drain the large area of Goldridge fine sandy loam. It consists of soil material washed from the adjacent hills. A large proportion of the type has been formed since cultivation of these hill lands began about 50 years ago. The comparatively recent time of formation in part accounts for the variableness of the subsoil texture. In many places the type consists of a recent deposit of fine sandy loam overlying the Yolo silt loam type, which is the principal soil of the stream bottom. In some localities as much as 6 inches

or more of soil may accumulate in a year. Fences have in places become buried in the course of a few years.

The light-colored variation of this soil is of relatively small extent. Two small bodies are mapped about 1 mile east and southeast of Grant School, and one near Olivet School. A large body occupies most of the floor of the little valley at Hill School. One body of considerable size occurs on Windsor Creek below Windsor, and two are mapped in the western part of Alexander Valley. In these bodies the surface soil is mottled with numerous iron stains. The subsoil below the depth of 8 to 18 inches is a heavy silt loam to silty clay. It is light gray in color, mottled with pale yellow and iron stains.

The topography varies from nearly level along the watercourses to sloping on alluvial fans where the soil has been deposited by drainage ways that carry water only at times of very heavy rains. Drainage is in some cases good and in others deficient. Most of the land is subirrigated.

The Yolo fine sandy loam is used as pasture land and for the growing of alfalfa, small grain, corn, garden truck, and hops. Very little fruit is grown. Some of the land of the light-colored variation is being set out to vineyards and orchards. The type is very productive, but some of it is poorly drained, and it lies in a situation where it is subject to frosts. It is better suited to crops that make large vegetative growth than to fruits. The soil is friable and easy to cultivate. It has only a moderate content of organic matter.

Yolo fine sandy loam, stream-bottom phase.—The stream-bottom phase of the Yolo fine sandy loam differs from the typical soil of the alluvial fans in several ways. The color is a distinct brown rather than grayish brown. The soil profile is more uniform in texture than that of the typical soil, probably because the material has been deposited by larger streams. The subsoil is usually of the same color and texture as the surface soil, except at the head of the Russian River Valley near Cloverdale, where this phase as well as the other alluvial soils is shallow and rests upon incoherent gravel at depths of 1 to 3 feet below the surface.

This phase of the Yolo fine sandy loam occurs on the flood plains of the Russian River and Dry Creek. It usually lies next to the bed of the river, with the silt loam and silty clay loam types farther back from the stream bed. The surface is nearly level but is interrupted in places by abandoned stream channels. The land is well drained but is subject to annual overflows. The phase is considered one of the best hop soils in the area. Alfalfa and all kinds of general farm crops as well as prunes, grapes, and other fruits are grown. The soil is extremely rich and desirable.

Included with the stream-bottom phase of the Yolo fine sandy loam are a few small areas of relatively light textured soil which if more

extensive would be differentiated as the Yolo fine sand. It consists of a light grayish brown fine sand extending to a depth of 6 feet or more. The soil is very light and friable and easy to cultivate but is low in organic matter. In places it contains a small percentage of gravel. It is underlain at varying depths by river gravels. This soil is much more leachy and porous and less productive than the areas of fine sandy loam texture.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the typical Yolo fine sandy loam and its stream-bottom phase:

Mechanical analyses of Yolo fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573010.....	Soil.....	0.1	0.2	0.3	39.8	35.3	18.0	5.6
573011.....	Subsoil.....	.0	.2	.3	18.6	38.9	36.2	10.9
Flood-plain phase:								
573078.....	Soil.....	3.6	3.0	5.1	22.4	18.4	33.6	9.0
573079.....	Subsoil.....	.0	.4	1.2	15.6	33.0	40.6	7.6

YOLO LOAM.

The surface soil of the Yolo loam consists of a brown to dark grayish brown, friable loam, usually containing a small quantity of gravel and a good supply of organic matter. It is underlain at depths of 18 to 24 inches by a brown or light grayish brown, or in the lower depths yellowish-brown, loam, also containing gravel, usually in larger quantities than the surface soil, the percentage increasing with depth. The material may become compact in the lower depths.

Small bodies of the Yolo loam are scattered throughout the area near Cloverdale, in Alexander Valley, near Healdsburg, and along Mark West Creek and other small streams. The surface ranges from gently sloping to nearly flat, but is broken in places by the channels of shifting streams. Drainage is generally thorough, though occasional poorly drained depressions occur.

The Yolo loam is used for a wide variety of crops, ranging from grain and hay to hops. Fruits are grown in a small way. The soil is easily cultivated.

Yolo loam, stream-bottom phase.—The stream-bottom phase of the Yolo loam is differentiated from the areas of the type occupying alluvial fans because of its occurrence on true river flood plains subject to annual overflow. In composition it is very similar to the remainder of the type, consisting of a brown or grayish-brown loam underlain by a subsoil of about the same color and texture. Both surface soil

and subsoil contain a little gravel, and the content of this generally increases with depth.

This phase occurs in small areas bordering the Russian River. The largest area is mapped at Geyserville and upstream from that town. The phase has a level or gently undulating surface and is somewhat subject to erosion by the Russian River in flood times. It has good drainage.

The Yolo loam, stream-bottom phase, is not very uniform in composition and agricultural value. Most of it is used for the production of grain and alfalfa. Grapes and prunes are grown on the areas near Geyserville and do very well. In the areas north of Geyserville the soil is of good depth and productive.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Yolo loam:

Mechanical analyses of Yolo loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573942	Soil	0.8	1.9	2.2	19.2	21.7	41.1	12.1
573943	Subsoil	4.6	5.2	7.2	11.6	13.3	45.0	13.0

YOLO SILT LOAM.

The Yolo silt loam consists of a brown to dark grayish brown silt loam, usually about 18 inches deep, passing gradually into a subsoil of brown or dark grayish brown silty clay loam. It has a good supply of organic matter, is retentive of moisture, and is rather friable and easily cultivated.

This type occurs in Alexander Valley and along Mark West and Santa Rosa Creeks. Small areas occur southeast of Healdsburg and along Green Valley Creek west of Graton. In a fair-sized area about three-fourths mile northeast of Lytton a very pronounced compact silty clay loam subsoil occurs at depths of 24 to 36 inches. This hinders subdrainage to such an extent that it materially lessens the agricultural value of the soil.

The surface of this type is nearly level, but drainage is in most places sufficient.

The areas along West Mark and Santa Rosa Creeks and near Healdsburg are mostly devoted to hops and prunes. On the other areas general farm crops are grown. The soil is productive and well suited to a wide range of crops.

Yolo silt loam, stream-bottom phase.—The stream-bottom phase of the Yolo silt loam differs from the alluvial-fan portion of the type in being friable to a greater depth, the soil almost invariably consisting

of a silt loam or light silty clay loam to a depth of 6 feet or more. The surface material when dry is often light grayish brown in color.

This is one of the most important and valuable soils in the area. It occurs in the flood plains of the Russian River and Dry Creek. Small areas are mapped from Cloverdale to Alexander Valley and large bodies occur in Alexander Valley and below Healdsburg. The surface is level and smooth, but drainage is almost invariably good. All this phase is in a high state of cultivation. In Dry Creek Valley it is devoted to fruit, largely prunes. In other places it is planted to hops, to which it is especially well suited, or is devoted to fruit, alfalfa or general farm crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo silt loam, stream-bottom phase:

Mechanical analyses of Yolo silt loam, stream-bottom phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573921	Soil	0.4	1.1	0.5	3.7	18.3	54.3	21.7
573922	Subsoil	1.3	1.1	.6	5.7	15.8	52.7	22.7

YOLO SILTY CLAY LOAM.

The surface soil of the Yolo silty clay loam consists typically of a brown or dark grayish brown silty clay loam averaging about 18 inches in depth and passing gradually into a subsoil of the same color and of the same or slightly heavier texture. Thin beds of gravel or strata of other material of lighter texture often occur in the subsoil. The soil is quite compact, is apt to clod, especially if handled when too wet, and is cultivated with considerable difficulty. It contains a good supply of organic matter.

This type is of relatively small extent. Some fair-sized areas occur near Old Windsor and the Sotoyome School, along Santa Rosa, Windsor, and Porter Creeks, and north of Fulton and Lytton. The surface is level or depressed, and in many places the drainage is poor.

The Yolo silty clay loam is used in the production of the general farm crops and fruits. The area north of Windsor is well adapted to the prune. Two areas mapped with this type in Alexander Valley, one near Hill School and one south of Healdsburg west of the Russian River are low in silt content, the soil here approximating a clay loam in texture. These areas have a crop adaptation similar to the silty clay loam.

A light-colored variation of this type occurs, in which the soil is a brownish-gray or light grayish brown silty clay loam, 12 to 24 inches deep, compact and hard when dry, sticky when wet, and apparently

low in organic matter. The subsoil is a grayish-brown silty clay loam or clay loam, showing many iron stains, and, in places, compact in the lower part of the 6-foot profile. Areas of this variation are of small extent. One of fair size occurs on Santa Rosa Creek, just above its junction with the Laguna de Santa Rosa and another 2 miles north of Sebastopol. The surface is in general level, though dissected in places by old stream channels. Drainage is rather poor. All this variation is used for pasture.

Yolo silty clay loam, stream-bottom phase.—The Yolo silty clay loam, stream-bottom phase, is very similar to the typical soil. The subsoil may be mottled in places with iron stains and ranges from silty clay loam to silty clay in texture. In a part of the area lying at the lower end of Dry Creek Valley the soil is light brown in color and is mottled with iron stains to the surface, owing, no doubt, to poor drainage. The subsoil here is a heavy silt loam.

This phase is much less extensive than the stream-bottom phase of the Yolo silt loam. It occupies basins or depressions within the larger bodies of the silt loam or occurs in strips between the silt loam type and the bluff which limits the river bottoms. The movement of the water in these places has evidently been slow and there has been opportunity for the clay to settle, resulting in the heavier texture of this soil. The phase occurs in Dry Creek Valley, in Alexander Valley, and on the Russian River flood plain south of Healdsburg.

This soil is used for the same crops as the associated silt loam. Much of it is poorly drained and is used as pasture land. It occurs in such small bodies that little is known of its crop adaptation. Hop growers realize that it is much less desirable for hops than the stream-bottom phase of the Yolo silt loam. It seems well suited to alfalfa where the drainage conditions are favorable. A considerable acreage is in grain. The soil is very productive but somewhat hard to till.

TEHAMA GRAVELLY LOAM.

The Tehama gravelly loam is indicated on the map by gravel symbols in the color used for the Tehama loam. The surface soil is a light yellowish brown or light grayish brown, friable loam carrying a large content of gravel. It varies from 18 to 30 inches in depth. The subsoil consists of a yellowish-brown or grayish-brown gravelly loam to gravelly clay loam, in places mottled with gray. The gravel consists largely of rounded fragments of hard metamorphosed sandstone and shale. Many of the stones contain seams of quartz and some of them are nearly pure quartz.

This type is distributed throughout the northern part of the area near Cloverdale, near Independence School, near Lytton, and south of The Forks. It also occurs in several places in Alexander

Valley and in Dry Creek Valley. It lies usually near the hills at the margin of the valleys, where it occupies smooth, gentle slopes. There is practically no surface erosion, but in some places water may cut the ditches deeper than is desirable. The drainage is in general good, but some of the shallow sloughs need drainage. The type is largely devoted to grapes and prunes. Grain hay is produced in places, and part of the area is used for pasture. The yields are very satisfactory.

In the following table are shown the results of mechanical analyses of samples of the soil and subsoil of the Tehama gravelly loam:

Mechanical analyses of Tehama gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573040	Soil	4.5	5.9	3.3	13.5	12.7	40.1	19.8
573041	Subsoil	4.6	3.2	4.6	14.0	12.3	34.0	30.5

TEHAMA LOAM.

The surface soil of the Tehama loam is typically a light yellowish brown or light grayish brown loam about 2 feet deep. The subsoil is a trifle lighter in color and ranges from loam to clay loam in texture. Some gravel occurs scattered through both surface soil and subsoil. The soil shows field indications of being mildly acid. In an area of a few acres included in this type on the Moulton Hill vineyard, south of Cloverdale, the soil consists of a clay loam underlain at about 18 inches by a pale-yellow clay. The type grades into the Yolo soils and as mapped may include some undifferentiated Yolo material.

The Tehama loam is distributed throughout the northern part of the area. Bodies occur south of Cloverdale, near Chianti, at several places in Alexander Valley, and at the head of Dry Creek Valley. The type does not occur in the southern part of the area. It has a gently sloping, smooth surface, and drainage is almost everywhere thorough, but erosion is serious in only a few places.

This is a friable, easily cultivated soil, well suited to the production of the general farm crops and fruit. Much of it is devoted to grapes and other fruits. Grapes do fairly well on it. Some of the land is used only for pasture.

In an area mapped with this type on the southern limits of Cloverdale the soil consists of an ashy-gray sticky loam, which becomes decidedly brown when saturated. This material is about 2 feet deep and is underlain by a stiff, tenacious clay loam or clay subsoil, under which a more or less cemented stratum of gravel occurs at depths of

4 to 6 feet. The soil is apparently low in organic matter and in an acid condition. The land is poorly drained in places, difficult to cultivate, and decidedly inferior to the typical soil. It is mostly devoted to grapes.

DUBLIN LOAM.

The surface soil of the typical Dublin loam is a dark-gray to black loam, 12 to 20 inches deep. The subsoil is a brown or gray loam or clay loam, usually variable in texture and containing thin beds of gravelly loam. The soil is easily tilled and retentive of moisture, owing in part to its rather high content of organic matter.

This soil type occurs in two general sections. It is encountered on alluvial fans along small streams within the large areas of Goldridge fine sandy loam west of Sebastopol and on the large compound fan of Mark West Creek. In both these places it occurs in scattered bodies. The surface is gently sloping to nearly level. Almost all the type is drained, but erosion is not active. The soil is productive and has a wide range of use. Hops, prunes, grapes, grain, and garden truck are extensively grown and all do well.

Dublin loam, light phase.—The soil of the Dublin loam, light phase, is a dark-gray to black, friable fine sandy loam to light loam, 12 to 20 inches deep, containing a good supply of organic matter. The subsoil to a depth of 3 to 6 feet is a brown or gray fine sandy loam or in places silt loam. This phase averages lighter in color than the heavier members of the Dublin series and when dry may be gray in color. Bedrock similar to that underlying the closely associated Goldridge fine sandy loam occurs within 3 feet of the surface. In such localities some of the material may be residual in origin.

This phase is of small extent. It occurs in small areas on alluvial fans and in stream bottoms lying within the large bodies of Goldridge fine sandy loam, from which the material has been derived by erosion and water transportation. The dark color is due to the relatively poor drainage and the accumulation of the remains of a luxuriant growth of grass. Areas of the type are mapped near Forestville, near Taylor, north, southwest, and northeast of Graton, and one southwest of Spring Hill School. The surface ranges from gently sloping to nearly level. Drainage is often poor, and there is almost no erosion.

The Dublin loam, light phase, occurs within an extensive fruit section, but has no recognized special-crop adaptation. The more poorly drained land is in pasture. Where the drainage is better brambleberries, hops or tree fruits are produced. Some of the soil, with a high organic content, is very productive. Other parts, owing to the shallowness of the soil and seepy conditions, are not suitable for fruit growing.

In the following table are given the results of the mechanical analyses of samples of the soil and subsoil of the typical Dublin loam:

Mechanical analyses of Dublin loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573908	Soil	1.4	2.9	1.8	23.6	22.0	27.2	21.9
573909	Subsoil	3.1	6.7	3.5	20.7	21.6	24.0	12.6

DUBLIN CLAY LOAM.

The Dublin clay loam typically consists of a dark-gray or black clay loam which grades at a depth of 12 to 30 inches into a grayish-brown, gray or light-brown subsoil of the same or slightly different texture, extending to a depth of 6 feet or more. Gravel or other coarse layers occur in places, but they have little effect on the agricultural value of the type.

Aside from a tendency to puddle in places where drainage is stagnated, the soil is fairly easy to till. It is absorptive of moisture and maintains a good supply through the dry season. Like the other Dublin soils, the type contains much organic matter. It is calcareous, especially in the subsoil.

Several small areas of this type border the level parts of the valley east of Preston, near Asti, and north of Geyserville. Larger bodies of considerable importance are mapped along Mark West Creek near Fulton, on the same fan north of Fulton, and near Santa Rosa Creek. Smaller bodies occur near Wright School and in the southern part of the area.

The surface of the Dublin clay loam is smooth and nearly level. Drainage ranges from fair to good. The soil is fairly productive, but restricted in crop adaptation. It is not suitable for the production of most fruits or hops, but the small grains do well, and a few vineyards are doing fairly well.

DUBLIN CLAY ADOBE.

The Dublin clay adobe consists of a dark-gray or black clay which is exceedingly sticky when wet and becomes very compact and flinty when dry, showing the typical adobe structure. At depths ranging from 10 to 36 inches, the dark-colored surface soil grades into a subsoil of light-brown, light grayish brown or yellowish-brown, compact clay loam or clay, which extends to a depth of more than 6 feet. Cultivation is easier than on most soils of such heavy tex-

ture, owing to the granulation of the material. The soil apparently contains much organic matter.

This soil is distributed throughout the area. Small bodies occur south of Cloverdale, north of Asti, and near Lytton and Hill School. Larger areas occur in Alexander Valley, south and west of Fulton, and south of Wright School. The type is also mapped north of Healdsburg and on the east side of the Laguna de Santa Rosa. It has a practically level surface and drainage is incomplete in many places, ditching being necessary to bring the soil into a condition suitable for cultivation. Subdrainage is also inadequate, owing to the dense structure of the soil and subsoil.

This type is largely devoted to grain and grain hay or is used as pasture. It is not well suited to the production of fruit, though a few vineyards on it give fairly satisfactory results.

In the following table are shown the results of mechanical analyses of samples of the soil and subsoil of the Dublin clay adobe:

Mechanical analyses of Dublin clay adobe.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
573962	Soil	0.2	1.2	1.3	9.9	10.0	35.8	41.8
573963	Subsoil	.5	.6	.6	7.6	11.9	30.0	48.4

ROUGH MOUNTAINOUS LAND.

Rough mountainous land, which includes soils of a number of series, forms the larger part of the hill lands bordering the valley proper on all sides. The hills rise rather abruptly from the relatively level valley floor to altitudes ranging from 500 to probably 2,500 feet above. Very little of the included land is rough and stony, and there are only a few rock outcrops, but the slopes are too steep to plow and are nonagricultural mainly for that reason. Many of them are covered with residual soils that are shallow and subject to severe erosion. Small areas of arable soil occur scattered through the hills on the more gentle slopes and in little valleys. Most of these have been cleared and are being farmed. Some of the more gentle hills, in areas underlain by the softer sandstones and shales, are grass-covered and parklike in appearance, with scattered valley-oak and blue-oak trees. The shallow soil covering is mostly of the Altamont series.

The hills composed of harder rocks, consisting of metamorphosed sedimentary rocks, are steeper and contain more rock outcrops.

The shallow soils of these hills belong mainly in the Aiken and Olympic series. The vegetative covering consists of the common trees and shrubs indigenous to the region, with Douglas fir and redwood in the ravines and on sheltered hillsides, and oaks of various species on many of the more moderate slopes. Many of the more exposed hilltops have no tree growth, but are covered with brush and shrubs.

The Rough mountainous land affords valuable pasturage, the best occurring where the forest is most open. It is stated that these areas will support 1 steer to each 10 acres. Some of the chaparral-covered hills are practically worthless for pasture. The forests are a source of firewood and charcoal. All the trees suitable for lumber have been removed.

RIVERWASH.

Riverwash includes areas of sand and gravel occupying low-lying, flood-swept situations along the Russian River and its larger tributaries. For the most part it is devoid of vegetation, but in places there is a growth of willow, cottonwood, and annual weeds. The land is all nonagricultural.

SUMMARY.

The Healdsburg area lies in the central and north-central parts of Sonoma County, Cal. It consists of relatively level valley lands and low hills surrounded by higher hills which are mainly nonarable, and includes the Russian River Valley, Dry Creek Valley, part of the Santa Rosa Plain, and the Goldridge district. It includes practically all the agricultural land in Sonoma County that was not covered by the adjoining soil survey of the San Francisco Bay region.

The area lies in the drainage basin of the Russian River.

Settlement of the area began about 1850. The population is predominantly Anglo-Saxon in origin. Settlement is quite dense in the Goldridge district and on the better alluvial lands, but is much more sparse in other parts of the area. Healdsburg, Geyserville, Cloverdale, and Sebastopol are the principal towns.

The main line and branches of the Northwestern Pacific Railroad traverse the area and give access to outside markets. An electric line connects the southern part of the area with Santa Rosa and Petaluma on the east and south.

The climate is characteristic of the Coast Range region of northern California. The rainfall, occurring mostly in the winter months, averages between 35 and 40 inches a year. The mean annual temperature at Healdsburg is 56.2° F. The winds are prevailingly from the west and northwest. The climate seems well suited to a wide range of fruit and general farm crops.

The early agriculture of the area consisted mostly of stock raising, although the growing of grain, fruit, and potatoes was begun at almost the same time. Hop culture began about 1872. There has been a gradual development of fruit growing and other intensive forms of agriculture at the expense of grain growing and stock raising.

The principal fruits of the region are grapes, apples, cherries, prunes, plums, pears, peaches, and brambleberries. Citrus fruits are grown in a small way around Cloverdale. Tomatoes and berries are grown as auxiliary crops in young orchards. There is a large output of canned fruits and vegetables. Tomatoes, berries, pears, and peaches are the leading canned products. Hops are the principal crop on many of the better alluvial soils, and hop production is an important industry.

The production of wine grapes is probably the largest farm interest in the area. There are over 100 wineries, and these place on the market about 7,500,000 gallons of dry wines each year.

Alfalfa is grown in a small way in connection with dairying, which is an important industry on the soils not suited to fruit and grain growing. Grain and grain hay are still extensively grown, the production of hay being larger than the quantity required for consumption in the area.

Cattle, sheep, and hogs are pastured on the rougher lands of the area.

The price of farm lands varies greatly. The better alluvial soils bring from $200 to $400 an acre in an undeveloped condition, while some of the hill lands may be bought for $5 an acre.

The soils of the Healdsburg area include those of residual origin, those derived through weathering from old unconsolidated valley-filling deposits, and those of recent-alluvial origin. The residual soils are represented by the Aiken, Olympic, Altamont, Sites, Butte, and Goldridge series. The soils derived from old valley-filling material consist of the Fresno, Madera, Corning, Pleasanton, and Pinole series. The recent-alluvial soils are represented by the Yolo, Honcut, Tehama, and Dublin series. In addition to these soils, two miscellaneous types, Riverwash and Rough mountainous land, are mapped.

Among the residual soils the Aiken series, with one type; the Olympic, with three types; and the Butte, with one type, are agriculturally rather unimportant. The Sites gravelly loam, the only member of the Sites series mapped, covers a moderate-sized area, but has a low agricultural value. The Altamont series, with three members, is quite extensive, and the agricultural value of the soils varies from low to very good. The Goldridge fine sandy loam, the only type of the Goldridge series encountered, is quite extensive, and is a very valuable soil. The Sebastopol fruit district has been developed largely on this type.

Among the soils derived from the old valley-filling material the Fresno and Madera soils, though extensive, are among the less valuable, being used largely as pasture land. The two Corning soils, mainly found on high terraces, are productive. The Pleasanton gravelly sandy loam occurs on lower terraces, and is also a desirable type. The Pinole gravelly loam is of medium productiveness.

The recent-alluvial soils are the most valuable in the area, and include a large proportion of the best developed land. Of these the Yolo soils and phases are the most extensive and most valuable agriculturally.

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[PUBLIC RESOLUTION—NO. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

Areas surveyed in California.

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